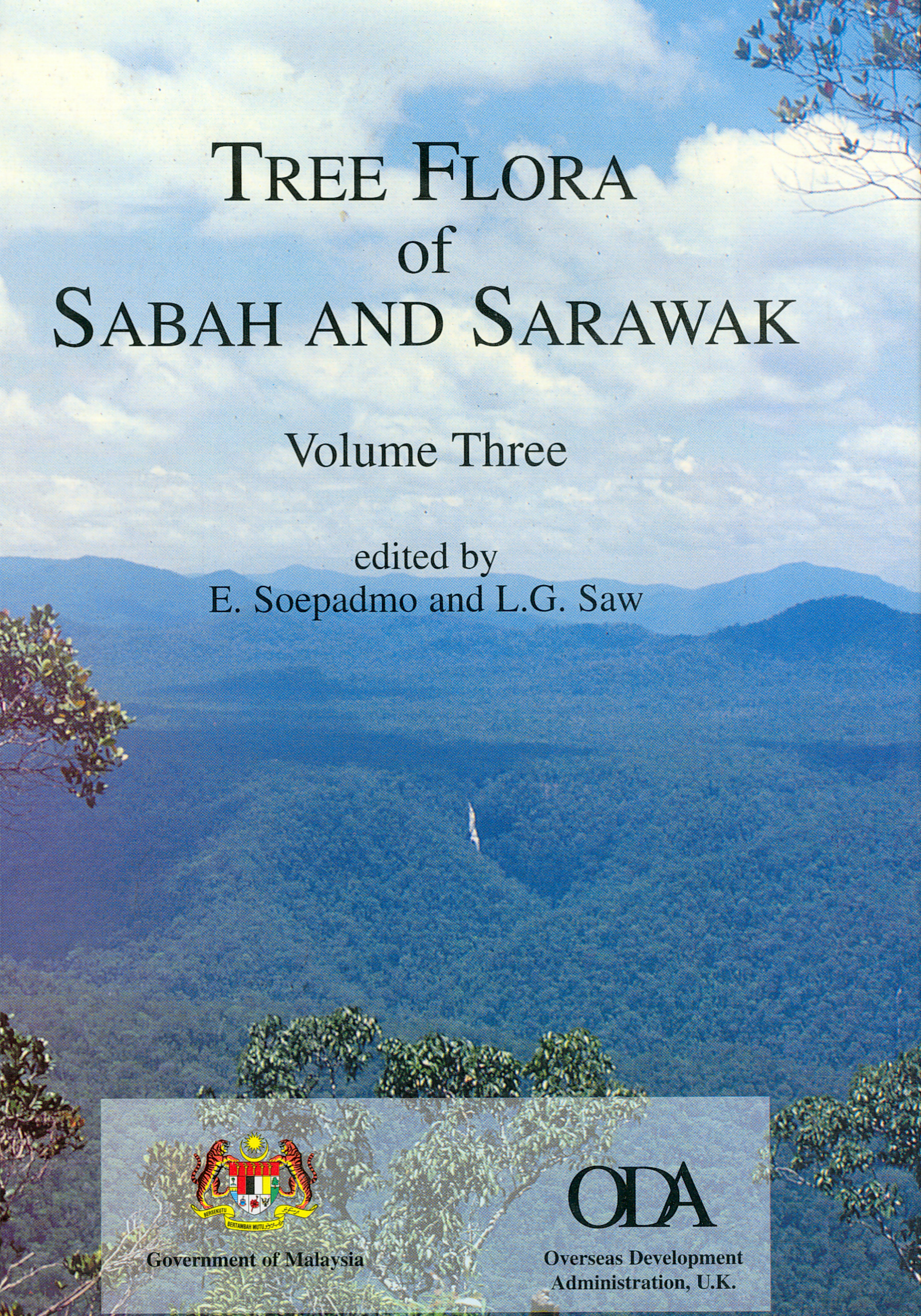

TREE FLORA of SABAH AND SARAWAK

Volume Three

edited by
E. Soepadmo and L.G. Saw

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TREE FLORA
of
SABAH AND SARAWAK

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FOREWORD

Once again we are delighted to be able to welcome a new volume of the *Tree Flora of Sabah and Sarawak*. This volume contains accounts of 4 families (Fagaceae, Leguminosae-Caesalpinioideae, Moraceae, and Myristicaceae) comprising 34 genera and 431 species. We learn that of the total 431 tree species treated in this volume, 28 species or 9.8% are new to science, and 176 species or 40.8% are endemic either to Borneo or to Sabah and Sarawak. Of the endemic species, 44 or 10.2% are hyper-endemic being rare and restricted in their distribution to a particular type of forest habitat, and are known only from a single or a few localities in Sabah and Sarawak. We also understand that 11 of the new species belong to the Fagaceae, a family already revised 27 years ago under the *Flora Malesiana* project, and 17 species belong to the Moraceae, a family yet to be revised under the *Flora Malesiana* project. The family Leguminosae-Caesalpinioideae had fairly recently been revised for *Flora Malesiana* (Ding Hou, K. Larsen & S.S. Larsen, 1996), while the Myristicaceae have yet to be published in the same Flora. Thus, Dr. W.J.J.O. de Wilde's account on the Myristicaceae for Sabah and Sarawak represents the most up-to-date treatment of the family for the region. It contains descriptions of 110 tree species in 5 genera, representing almost three-fold the number of species listed by Merrill in 1921 and nearly two-fold the number of species enumerated by Masamune in 1942 for Borneo. The results demonstrate once again that continued exploration of the tree flora of Sabah and Sarawak, followed by detailed scientific investigation and accurate documentation, will yield valuable information pertaining to the botanical and conservation status of the tree resources of Sabah and Sarawak. Such information is pivotal to our understanding of the biological diversity of Borneo in general and that of Sabah and Sarawak in particular. The availability of fundamental botanical information on the *Tree Flora of Sabah and Saraw*ak (TFSS) will further enhance our capability to protect, conserve, use and manage tree resources on a sustainable basis. At the national level, the publication of TFSS volume 3 symbolises the Malaysian Government's commitment towards achieving its National Policy on Biological Diversity launched in April 1998. In the international arena, the publication also proves that the Malaysian Government is fully committed in fulfilling its obligations and responsibilities under the International Convention on Biological Diversity.

Funding for a long-term project is a notorious problem, perennially faced by research institutions that embark on such a project. Between 1996 and 1999, no additional international funding was available for the *Tree Flora of Sabah and Sarawak Project*, resulting in the drastic reduction of its activities and the delay of publication of TFSS volume 3. However, we are extremely grateful for the timely approval of research grant in 1996 by the Malaysian Government (through the IRPA grant for Project 08–04–01–0024/1996) and further additional support in 1997 from the Malaysian Forestry Research and Development Board (MFRDB). We also wish to acknowledge the generosity of the Overseas Development Administration of the United Kingdom for allowing the

Project to continue utilising the balance of funds approved in the 1996/1997 Financial Year.

To continue the project, and thus to achieve its original objective of producing 8 volumes of the *Tree Flora of Sabah and Sarawak*, we earnestly hope that in the new millennium the Project would be able to attract enough funding from both national and international agencies.

We wish to express our deepest gratitude to various national and international research institutions for their help and collaboration in making the publication of the *Tree Flora of Sabah and Sarawak* volume 3 possible. To the contributors of this volume, we wish to congratulate them for their excellent achievement. Finally, our thanks and congratulations are also due to the editors of this volume and to staff of the Forest Research Institute Malaysia (FRIM), Sabah Forestry Department, and Sarawak Forestry Department for their support and involvement in the project.

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E. Soepadmo
December 1999 L.G. Saw

DEDICATION

Kizhakkedathu Mathai Kochummen

(6 July 1931, Kerala, India–31 March 1999, Kuala Lumpur, Malaysia)

The birth of *Tree Flora of Sabah and Sarawak* volume 3 sadly coincided with the untimely departure of K.M. Kochummen on 31 March 1999 at the age of 67, following a brief spell of illness. With his demise we also lost the most experienced and much respected Forest Botanist.

Born in Kerala on 6 July 1931, Koch, as his peers and friends affectionately knew him, obtained his B.Sc. degree from the University of Travancore, Kerala in 1951 (van Steenis-Kruseman, 1974). He came to Malaya in December 1952 and joined the Forest Research Institute (FRI) at Kepong in January 1953 as Research Assistant. He worked under the guidance and leadership of John Wyatt-Smith, who was then the Forest Botanist of the Institute. In 1957 he was promoted to Assistant Forest Botanist, and subsequently took charge of the Kepong herbarium during 1960–1963. In 1968, he went to the University of Edinburgh, U.K., to pursue a Diploma Course in Plant Taxonomy under the Colombo Plan Scholarship Award. Following his return to Kepong, he was promoted first to Forest Botanist in 1971, and then to Senior Forest Botanist in 1980 (Wong, 1987). He retired from the Institute in 1986 after 33 years of service. Immediately after his retirement, Koch took up a consultancy assignment as Senior Research Fellow (1986–1991) with the Smithsonian Tropical Research Institute (STRI) to identify and enumerate tree species in the 50-ha demographic plot in Pasoh Forest Reserve, Negri Sembilan (Kiew, 1999). From 1992 to his demise in March 1999, the *Tree Flora of Sabah and Sarawak Project* based at the Kepong herbarium engaged Koch as Senior Botanist.

Koch's major botanical contribution hinged largely on his unrivalled natural ability in recognising tree species by their leaf and other readily accessible field/vegetative characters, such as those of the bark, bole, exudate, buttress, and root system. This unsurpassed ability was acquired and sharpened during his first decade of service at Kepong, spurred by the need for botanical and ecological data of all timber species native to Malaya. This fundamental information was vital and essential to the success of Wyatt-Smith's monumental undertaking to produce the *Manual of Malayan Silviculture for Inland Forests* (Ng & Saw, 1999). Koch's hard work and relentless effort resulted in the publication of his '*Keys for the botanical identification of non-dipterocarp timber trees of Malaya, based on field characters*' (FRI Research Pamphlet No. 43, 1963). After further testing and improvement of his approach and methodology of field identification, Koch used his practical knowledge and experience to revise Wyatt-Smith's *Pocket Check List of Timber Trees* (first published in 1952). The much-improved *Pocket Check List* was published in 1964.

The next major assignment in Koch's botanical career at FRI began when the Institute, with the financial assistance of the Colombo Plan Technical Aid Programme, embarked on another monumental project, the *Tree Flora of Malaya*. Under this project, T.C. Whitmore was engaged as the leader and coordinator during 1965–1972. The first and second volumes of the *Tree Flora*, edited by T.C. Whitmore, were published in 1972 and 1973 respectively. The third and fourth volumes, edited by F.S.P. Ng, appeared in 1978 and 1989, respectively. A total of 100 families comprising 2677 tree species were treated in these volumes. Koch contributed revisions of 26 families embracing 1089 species (about 41% of the total). Despite his heavy commitment with the project, Koch was always mindful of his responsibility in ensuring the usefulness of Wyatt-Smith's *Pocket Check List of Timber Trees*. Hence, in 1976 he began to revise the book by incorporating more up-to-date botanical and other information generated by the publication of the first two volumes of the *Tree Flora of Malaya* and other sources such as monographic accounts of families published in the *Flora Malesiana* volumes. The revised *Pocket Check List* was eventually published in 1979.

Being indefatigable in his botanical ambition, Koch, after retirement, continued to make significant contributions towards the betterment of our knowledge of the tree flora of Malaysia. Under the leadership of P.S. Ashton (Harvard University) and in collaboration with other scientists involved in the STRI Project (1986–1991), Koch managed to establish the species identities of a staggering 335,240 juvenile and mature trees (with dbh = 1 cm and greater) enumerated in the 50-ha demographic plot at Pasoh Forest Reserve (Manokaran *et al.*,1992). As a testimony of his unsurpassed knowledge on the usefulness of vegetative characters for identifying forest trees, Koch, in 1997, published his book on the *Tree Flora of Pasoh Forest*.

The final chapter of Koch's illustrious botanical achievements is epitomised by his involvement in the *Tree Flora of Sabah and Sarawak* (TFSS) *Project*, jointly carried out by the Forest Research Institute Malaysia (FRIM), Sabah Forestry Department, and Sarawak Forestry Department. In 1992, he joined the Project as Senior Botanist with a special task of revising large and difficult families. During his tenure, he contributed revisions of the Burseraceae, Celastraceae and Ochnaceae published in the TFSS volume 1 (1995), and of the Anacardiaceae in volume 2 (1996). In December 1998, Koch completed the manuscript of the Moraceae (*Artocarpus* and *Ficus*) published in this volume. Apart from revising families for the TFSS volumes, Koch also actively participated in the workshop and training courses organised by the project to upgrade the taxonomic research capability of 25 young Malaysian botanists involved in the project. To them, Koch was a good teacher and friendly instructor. Concurrent with his duty under the TFSS Project, Koch also revised Wyatt-Smith's *Pocket Check List* for the third time. The much extended and updated edition was published by FRIM in the middle of 1999, just a few months after his departure. Beside his enormous contribution towards the advancement of our knowledge of the Malaysian flora, his peers and friends in Malaysia as well as in other parts of the world will remember the humble and soft-spoken Koch for his unfailling courtesy and willingness to share knowledge with others.

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Eponymy

Alseodaphne kochummenii Kosterm. (Lauraceae). **Candollea 28** (1973) 115.

Diospyros kochummenii Ng (Ebenaceae). **Malay. For. 40** (1977) 227.
Erythroxylum kochummenii Ng (Erythroxylaceae). **Gard. Bull. Sing. 28** (1976) 235.
Kochummenia K.M. Wong (Rubiaceae). **Malay. Nat. J. 38** (1984) 31.
Lithocarpus kochummenii S. Julia & Soepadmo (Fagaceae). **Gard. Bull. Sing. 50** (1998) 134.
Mesua kochummenii Whitmore (Clusiaceae). **Gard. Bull. Sing. 26** (1973) 280.

E. Soepadmo
December 1999
L.G. Saw

FAGACEAE

E. Soepadmo, S. Julia[1] & Rusea Go[2]

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Dumortier, Ann. Fam. Pl. (1829) 59 (Fagineae); A. De Candolle, Prodr. 16, 2 (1864) 1 (Cupuliferae); Oersted, Köngl. Danske Vid. Selsk. Skrift. 5, 9 (1871) 351 (Cupuliferae); Prantl *in* Engler & Prantl, Nat. Pflz. Fam. 3, 1 (1889) 52 (Fagaceae); King, Ann. Roy. Bot. Gard. Calc. 2 (1889) 17; Gamble, J. As. Soc. Beng. 75, 2 (1915) 406; Koidzumi, Bot. Mag. Tokyo 30 (1916) 186; Rehder, J. Arn. Arb. 1 (1919) 121, *ibid.* 10 (1929) 132; Merrill, EB (1921) 210; Ridley, FMP 3 (1924) 372; Masamune, EPB (1942) 232; Barnett, Trans. Proc. Bot. Soc. Edinb. 34 (1942) 327, *ibid.* 34 (1944) 159; Backer & Bakhuizen *f.*, FJ 2 (1965) 2; Soepadmo, FM 1, 7 (1972) 265; Cockburn, TFM 1 (1972) 196, TS 1 (1976) 85; Anderson, CLTS (1980) 197; Corner, WSTM 3rd. edition 1 (1988) 327; Whitmore, Tantra & Sutisna CLK 2, 1 (1990) 152; Kubitzki *in* Kubitzki *et al.* (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 301; Turner, Gard. Bull. Sing. 47 (1995) 234; Coode *et al.* (eds.), CLBD (1996) 123; Argent *et al.* (eds.), MNDT-CK 1 (1997) 237.

Monoecious, evergreen trees or shrubs; buttresses or stilt-roots sometimes present; growth mode flush-wise, with perular buds. **Indumentum** comprising simple, stellate or fascicled hairs. **Stipules** caducous or rather long persistent, inter- or extra-petiolar. **Leaves** *simple*, *spirally arranged*, *in whorls of 3* (*Trigonobalanus*), *distichous* (a few species of *Castanopsis*), or *crowded near the top of twigs* (species of *Quercus*), *pinnately veined*, margin entire, denticulate, serrulate, crenate or lobed. **Inflorescences** *unbranched* or *branched*, *bracteate spikes*; *male*, *female*, *androgynous*, *or mixed*. **Male inflorescences** erect or pendulous, in the axils of lower (proximal) leaves or in the axils of reduced leaves and crowded together in paniculate clustes on lateral or subterminal new shoots. **Male flowers** *solitary or in dichasial clusters of 3–7(–30) along the rachis*, sessile; *perianth campanulate*, *6(–9)-lobed*; *stamens (4–)6–12(–15)*, *filaments* filiform, exserted, *free*; *anthers* reniform or ovoid, *dorsi- or basifixed*, *longitudinally dehiscent*; *pistillode absent or present*, if present densely hairy. **Female**, **androgynous** and **mixed inflorescences** erect, in the axils of upper (distal) leaves or on the lower parts of paniculate clusters on lateral or subterminal new shoots. **Female flowers** sessile, *solitary or in dichasial clusters of 3–15 along the rachis*; *each flower surrounded by its own cupule* (*Lithocarpus* and *Quercus*) or *the entire cluster of flowers surrounded by a dichasial cupule* (*Castanopsis* and *Trigonobalanus*); *perianth 6-lobed*; *staminodes 6–12 or absent*; *ovary inferior*, *3–6(–9)-loculed*, *ovules anatropous*, 2 per locule, *apical and pendulous*; styles as many as ovary locules, terete, conical, or cylindrical, *stigmas capitate* (*Quercus* and *Trigonobalanus*) or *punctiform* (*Castanopsis* and *Lithocarpus*). **Cupules** (woody or horny structures covering or substending flowers/fruits) sessile or stalked, *solitary or in dichasial clusters along the rachis*, *saucer- to cup-shaped or completely enclosing the*

Current address: [1]Sarawak Biodiversity Centre, Kuching, Malaysia; [2]Universiti Putra Malaysia, Serdang, Malaysia *fruit*, *at maturity indehiscent or splitting into 2–8 (or more) equal or unequal segments*; *external wall muricate*, *scaly*, *spiny*, *tubercled*, *or with concentric or spiral lamellae*, or rarely almost smooth. **Fruits** *indehiscent nuts*, 1–3-loculed, sometimes falsely multiseptate, *rounded to sharply 3-angular in cross-section*, at base with flat, concave or convex circular or rounded-triangular scar. **Seeds** *without endosperm*; embryo large, cotyledons large, flat-convex, plicate or ruminate; germination epigeal or hypogeal.

Distribution. About eight genera with more than 800 species, distributed both in the temperate (up to 62ºN and 33ºS) and tropical regions but mostly in the northern hemisphere. In the Malesian region, there are 5 genera with about 180 species, distributed from Peninsular Malaysia southeast- and eastwards to New Britain and the Louisiades Islands in the Pacific. The family is poorly represented in the seasonally dry parts of C and E Java, and absent in the Lesser Sunda Islands, northern parts of Maluku, New Ireland and the Solomon Islands. In Sabah and Sarawak, the family is represented by 4 genera comprising 100 species. Of these 49 species are endemic to Borneo, and 17 species to Sabah and Sarawak.

Ecology. In Sabah and Sarawak, members of the Fagaceae are common constituents of the understorey, main canopy and rarely emergent layers of the lowland to montane forests, from sea level to about 3000 m altitude. Most species are however, found in hill mixed dipterocarp to lower montane forests, at altitude ranging from 500 to 1800 m, on a variety of soils. A few species, e.g. *Lithocarpus bullatus*, *L. tawaiensis*, *Q. kinabaluensis*, and *Q. lowii* are confined to ultrabasic soils, whereas others, e.g. *Castanopsis foxworthyi* and *L. andersonii* may be found in *kerangas* and peatswamp forests as well as in forests growing on well-drained, mineral-rich soils. A few species, such as *Lithocarpus bennettii*, *L. conocarpus*, *L. papillifer*, *L. rassa* and *L. sundaicus* occasionally occur in limestone habitats. Growth mode is flush-wise, and it is common for a reproductively matured tree to undergo multiple flushing during a particular growing period. Flowering is seasonal but in most species it is synchronous among reproducing species and individuals. Inflorescence primordia usually appear at the end of the rainy season which in Sabah and Sarawak takes place during the months of December through March. Floral anthesis occurs during the following dry season (April–June), and mature fruits are produced about 5 months later. In *Castanopsis*, *Lithocarpus* and *Trigonobalanus* pollination is affected by insects, while in *Quercus* is by wind. Dispersal of fruits (acorns or nuts) is carried out by arboreal vertebrates such as squirrels. Seed's sterility and mortality is relatively high, with the former is due to unsuccessful fertilization and the latter to predation and attack by weevils and fungi.

Uses. The medium to heavy hardwood timber of *Castanopsis* is traded as *berangan*, and that of *Lithocarpus* and *Quercus* as *mempening*. The timber is suitable for medium to heavy construction under cover, such as house post, beam joineries, and flooring. Duly processed, it is also suitable for furniture, cabinet making, interior fittings, panelling, and for manufacturing plywood and sliced veneers. Locally the wood is used for fence post, mining props, shingle, boat building, and for making tool handles, rice pounder, poles for carts, and for firewood and charcoal. Branches and stems are used as bed logs in mushroom cultivation. The bark of most species contains a high percentage of tannin and is occasionally used to tan leather and to dye rattan and cotton fabrics. The nuts of some species of *Castanopsis*, e.g. *C. costata*, *C. javanica*, *C. motleyana*, and *C. oviformis* are edible, and consumed after boiling or roasting.

Taxonomy and Classification. According to the widely accepted taxonomic concepts based largely on gross morphological attributes, the family Fagaceae is classified into three distinct subfamilies, namely the Castaneoideae comprising *Castanea*, *Castanopsis*, *Chrysolepis* and *Lithocarpus*, the Fagoideae with *Fagus* and *Nothofagus*, and the Quercoideae, consisting of *Quercus* and *Trigonobalanus*. In the recent years, however, a number of authors have either proposed to split the family into two distinct ones, *i.e.* the Fagaceae *s.s.* to include *Castanea*, *Castanopsis*, *Chrysolepis*, *Fagus*, *Lithocarpus*, *Quercus* and *Trigonobalanus*, and Nothofagaceae *s.s.* comprising the genus *Nothofagus*, or to split a few genera such as *Quercus* into two smaller genera, *Quercus s.s.* and *Cyclobalanopsis* (Nixon, K.C. & W.L. Crepet, Am. J. Bot. 76 (1989) 842–855), and *Trigonobalanus* into three smaller genera, *Trigonobalanus s.s.*, *Formanodendron* and *Colombobalanus* (Nixon, K.C. & W.L. Crepet, Am. J. Bot. 76 (1989) 828–841). At subfamily level, proposals have also been made to rearrange the genera into different subfamilies and tribes. For practical reasons, however, the current account follows Kubitzki's classification (1993).

Key to genera

(based on vegetative and field characters)

1. Leaves in whorls of 3. Trees coppicing……………........………………...**4. Trigonobalanus**
   Leaves spirally arranged or distichous. Trees not coppicing (except in *Castanopsis acuminatissima*)……….....………………………………......….……………………………....2

2. Petiole slender, distinctly thickened at the base, often kneed. Inner bark not growing into the sapwood. Wood with exclusively narrow-uniseriate rays.........…..**1. Castanopsis**
   Petiole thickened throughout its length or slender and thickened at the base but never kneed. Inner bark with ridges penetrating the sapwood. Wood with both narrow-uniseriate and broad-multiseriate rays………………………………………..........……..3

3. Leaves usually crowded near the ends of twigs; margin usually serrate or serrulate at least in the apical half, rarely entire. Terminal buds crowded at the ends of twigs. Petiole always thickened at the base…………………………..............………**3. Quercus**
   Leaves not crowded near the ends of twigs; margin always entire. Terminal buds solitary. Petiole thickened throughout its length……......………………...**2. Lithocarpus**

Key to genera

(for flowering and/or fruiting specimens)

1. Male inflorescences pendent, usually unbranched. Male flowers without pistillode. Female flowers usually without staminodes……………………….........…...**3. Quercus**
   Male inflorescences erect or pendent (*Trigonobalanus*), usually branched. Male flowers with pistillode. Female flowers with staminodes…………....………..……..2

2. Male flowers with basifixed anthers. Stigmas capitate. Cupules open, 3–12-lobed. Fruits trigonous in cross-section……………….…........…..……**4. Trigonobalanus**
   Male flowers with dorsifixed anthers. Stigmas minute, punctiform. Cupule open but not lobed, or completely covering the fruits, indehiscent or dehiscent into a definite number of segments. Fruits not trigonous in cross-section……..………..................3

3. Cupule completely covering (1–)3(–7) fruits; external wall tubercled or covered with rigid and woody spines, at maturity splitting into 2–4(–8) segments or irregularly…………………………………………………………………**1. Castanopsis**
Cupule open cup- or saucer-shaped, or if completely covering the fruit then indehiscent, enclosing or substending a solitary fruit; outer wall lamellate, scaly, or at most covered with flexible, slender, spine-like appendages………**2. Lithocarpus**

1. **CASTANOPSIS** (D. Don) Spach

(resembling *Castanea* = the Spanish chestnut)

berangan (Malay)

Hist. Veg. Phan. 2 (1842) 185; Merrill, EB (1921) 210; Masamune, EPB (1942) 232; Burkill, EPMP 1 (1966) 492; Soepadmo, Reinwardtia 7 (1968) 384, FM 1, 7 (1972) 294; Cockburn, TFM 1 (1972) 199, TS 1 (1976) 85; Anderson, CLTS (1980) 197; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 152; Kubitzki *in* Kubitzki *et al.* (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 307; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area, East Kalimantan (1994) 136; PROSEA 5, 2 (1995) 108; Coode *et al*. (eds.), CLBD (1996) 123; Argent *et al.* (eds.), MNDT-CK 1 (1997) 237. **Basionym:** *Quercus* L. subdiv. *Castanopsis* D. Don, Prod. Fl. Nep. (1825) 275. **Synonym:** *Callaeocarpus* Miq., Pl. Jungh. (1851) 13.

Trees, rarely buttressed. *Wood rays narrow and uniseriate*. **Bark** smooth or fissured or sometimes lenticellate; inner bark granular or fibrous, *not growing into the sapwood*. **Twigs** glabrous or hairy, lenticellate or smooth. **Stipules** *extrapetiolar*, small, caducous. *Terminal bud solitary*. **Leaves** *spirally arranged or distichous*, *margin entire or rarely toothed above the middle* (only in *Castanopsis acuminatissima*); *petiole thickened and usually kneed at the base*. **Inflorescences** *erect*, male, female, androgynous or mixed, densely stellate-pubescent. **Male inflorescences** in lateral or subterminal dense paniculate clusters on the new shoots or solitary in the axils of lower (proximal) leaves, branched or unbranched; bracts and bracteoles small, persistent. **Male flowers** solitary or in dichasial clusters of 3–7 along the rachis or in an androgynous inflorescences along the upper parts of the rachis; perianth 6-lobed; *stamens (7–)12*, filaments glabrous; *anthers dorsifixed*, reniform, 2-loculed, 4-lobed; *pistillode rudimentary or well developed*, more or less rounded, densely woolly pubescent. **Female**, **androgynous** or **mixed inflorescences** unbranched, solitary in the axils of upper (distal) leaves or in the upper parts of paniculate clusters on the new shoots; bracts and bracteoles usually larger and thicker than those of male inflorescences, persistent. **Female flowers** solitary or in clusters of 3–5 along the rachis or in an androgynous inflorescences along the basal parts of the rachis; perianth 6-lobed; *staminodes 10–12*, rudimentary; styles 3, conical or cylindrical, straight or recurved, densely hairy at the base; *stigma minute, terminal and punctiform*. **Cupules** *solitary along the rachis*, *completely enclosing 1–4(–7) nuts, surface variously spiny or set with short tubercles or almost smooth, at maturity spliting irregularly or into a regular number of segments*; spines branched or unbranched, *woody and rigid*, flat to triangular, straight or recurved, glabrous or pubescent, regularly or irregularly arranged on the cupule. **Fruits** (nuts) *more or less angular in cross-section*; wall woody, completely or partly adnate to the cupule. Seed germination hypogeal.

Distribution. About 120 species, distributed in NE India (Nepal, Bhutan, Assam), Burma, China (except N and NW parts), Korea, Japan, Formosa, Hainan, Indo-China, Thailand, and Malesia. In Malesia, throughout most islands except the eastern half of Java and in the Lesser Sunda Islands. The largest number of species are found in Borneo. In Sabah and Sarawak, the genus is represented by 21 species, of which 10 species are Bornean endemics.

Ecology. In primary and old secondary forests, from sea level up to 2500 m altitude, on different types of soils except limestone.

Uses. The nuts of several species are edible. The bark yields tannin and dye. The timber is used in medium to heavy construction work and in the manufacture of furniture, packing cases and pallets.

Key to *Castanopsis* species

1. Leaves narrowly ovate to lanceolate, margin toothed in the upper half. Trees with coppicing habit……………………………..............………..**1. C. acuminatissima**
Leaves not so, margin entire, plane or revolute. Trees not coppicing……………………..2

2. Leaves glabrous on both surfaces………………………………..…………………………3
Leaves sparsely to densely hairy below……………………….………...…………10

3. Intercostal venation lax, faintly prominent on both surfaces…………..…………………4
Intercostal venation dense, distinctly prominent on both surfaces……..…………………...5

4. Cupule subsessile, spines unbranched. Lateral veins disappearing near the leaf margin. Twig smooth…………………………………………………….....……**7. C. endertii**
Cupule with stalk *c*. 0.5 cm long, spines much-branched. Lateral veins joining near the leaf margin. Twig sparsely minute-lenticellate…………………...**8. C. evansii**

5. Leaves narrower, with a length:width ratio of 3–4:1. Cupule tubercled or almost smooth…………………………………………………………….....……………...6
Leaves wider, with a length:width ratio of 2–3:1. Cupule variously spiny……….……..7

6. Cupule almost smooth; stalk 1–1.5 cm long. Twig sparsely to densely lenticellate. Leaves elliptic to oblong; lateral veins joining near the leaf margin; petiole 15–20 mm long……………………………………….....…………**20. C. pedunculata**
Cupule tubercled, subsessile or with stalk 0.5–1 cm long. Twig smooth. Leaves ovate, lanceolate or elliptic; lateral veins disappearing near the leaf margin; petiole 8–13 mm long…………………………………..…...……...…..**21. C. psilophylla**

7. Cupule globose or subglobose. Petiole glabrous……………..………….…………8
Cupule ovoid, obovoid or ellipsoid. Petiole hairy……………..…..………………9

8. Cupule densely spiny; spines unbranched, slender; nuts 1 in each cupule. Leaves coriaceous, margin plane, lateral veins usually less than 7 pairs, joining near the

leaf margin……………………………………...…………………**2. C. borneensis**
Cupule sparsely spiny; spines branched, flat to triangular; nuts 3 in each cupule. Leaves thick-coriaceous, margin revolute, lateral veins usually more than 7 pairs, disappearing near the leaf margin……….…….…………………**9. C. foxworthyi**

9. Stipules usually persistent, 7–9 mm long. Leaves elliptic, margin plane, acumen 8–10 mm long; lateral veins disappearing near the leaf margin….....….**4. C. clemensii**
Stipules caducous, 3–5 mm long. Leaves elliptic, oblong or ovate, margin revolute, acumen *c*. 5 mm long; lateral veins joining near the leaf margin…..…**18. C. oviformis**

10. Twig densely covered with large lenticels…………………………….....………..11
Twig sparsely covered with minute or large lenticels or smooth or finely fissured…....12

11. Petiole 20–35 mm long. Cupule depressed subglobose, 2.5–4 cm in diameter, shortly spiny or tubercled; stalk thick and twisted; nut wall thick and woody. Leaf apex obtuse ………………………………….....……………………...**13. C. lucida**
Petiole (4–)6–8(–12) mm long. Cupule discoid, asymmetrical, 1–1.5 cm in diameter, spiny; stalk slender and straight; nut wall thin. Leaf apex acuminate, acumen 10–15 mm…………………………………....……….………...**12. C. javanica**

12. Leaf apex acute or short-acuminate, acumen *c*. 5 mm long………………….……13
Leaf apex long-acuminate, acumen 10–20 mm long, rarely acute...…………….……..17

13. Cupule stalk 0.5–0.7 cm long……………………........................………14
Cupule sessile or subsessile…………………………………......………..15

14. Lateral veins closely spaced. Nuts 1 in each cupule, free part glabrous……..................
....……**6. C. densinervia**
Lateral veins distantly spaced. Nuts 2–3 in each cupule, free part densely hairy……..…
………………………………………......……….…..……**5. C. costata**

15. Leaves ovate or elliptic, margin slightly revolute; midrib thin, lateral veins 5–7 pairs……………………………………......……....……**17. C. oligoneura**
Leaves elliptic-oblong or obovate, margin strongly revolute, midrib broad and strongly raised below, lateral veins 10–15 pairs……….........………………16

16. Mature cupule 5–8 × 3–5.5 cm; nuts 1 in each cupule, free apical part glabrous. Leaves elliptic-oblong, apex acute………………………………**14. C. megacarpa**
Mature cupule 2–3 × 1.5–2.5 cm; nuts 2–3 in each cupule, sparsely pilose at the apex. Leaves obovate or rarely elliptic-oblong, apex short-acuminate....**16. C. motleyana**

17. Leaves 5–8 × 1.5–2.5 cm, linear to lanceolate. Nuts 2–3 in each cupule, equally developed…………………………….....…...…………**15. C. microphylla**
Leaves (7–)11–17 × (3–)4–7 cm, ovate, elliptic, oblong, or ovate-lanceolate. Nuts usually only 1 well-developed in each cupule……………..........………18

18. Cupule stalk 0.5–1 cm long. Petiole strongly kneed at the base………………………19
Cupule subsessile. Petiole slightly kneed at the base……………………………20

19. Cupule subglobose, 2.5–3 × 2–2.5 cm; spines slender, irregularly arranged. Leaves thick-coriaceous; lateral veins disappearing near the leaf margin………….**10. C. fulva**
Cupule obovoid to ellipsoid, 4–4.5 × 3–3.5 cm; spines sturdy, flat to triangular, regularly arranged. Leaves thin-coriaceous; lateral veins joining near the leaf margin ……..………………………………………………………...……….**19. C. paucispina**

20. Leaves sparsely to densely covered with appressed stellate and hirsute hairs below; intercostal venation dense, scalariform, prominent on both surfaces. Cupule ovoid to ellipsoid, 7–10 × 4.5–7 cm; nut wall thick and woody, most part adnate to the cupule…………………………………………...…………**11. C. hypophoenicea**
Leaves sparsely tomentose below; intercostal venation lax, scalariform, weakly raised or almost obscure on both surfaces. Cupule ovoid to conical, *c.* 1.5 × 1 cm; nut wall thin, most part free from the cupule…..............………………...**3. C. buruana**

1. **Castanopsis acuminatissima** (Blume) A. DC.

(Latin, *acuminatissimus* = extremely long-pointed; the leaf tip)

J. Bot. 1 (1863) 182; Soepadmo *l.c.* (1968) 385, *l.c.* (1972) 307; Cockburn *l.c.* (1972) 201, *l.c.* (1976) 89; Whitmore, Tantra & Sutisna *l.c.* 152; PROSEA *l.c.* 108; Turner *l.c.* 234. **Basionym:** *Castanea acuminatissima* Blume., Mus. Bot.-Lugd. Bat. 1 (1850) 283. **Type:** *Blume s.n.* (= *RHL Sheet No. 901310451*), Java (holotype L). **Synonyms:** *Castanea sessilifolia* Blume *l.c.* 284; *Pasania acuminatissima* (Blume) Oerst., Vid. Medd. Naturh. For. Kjöb. 8 (1867) 84; *Quercus varingaefolia* Miq., Pl. Jungh. (1851) 12; *Quercus junghuhnii* Miq., Fl. Ind. Bat. 1, 1 (1856) 853; *Castanopsis junghuhnii* (Miq.) Markgr., Bot. Jahrb. 59 (1924) 62; *Quercus fagiformis* Jungh., Bonplandia 6 (1858) 83; *Synaedrys fagiformis* (Jungh.) Koidzumi, Bot. Mag. Tokyo 30 (1916) 187; *Castanopsis schlenkerae* Bailey, Queensl. Agr. J. 22 (1909) 149.

Tree up to 30 m tall, 50 cm diameter, *often coppicing*. **Bark** flaky or sometimes smooth, yellowish grey; inner bark granular, brownish yellow. **Sapwood** yellowish. **Twigs** densely pubescent when young, becoming glabrous, smooth or sometimes minute-lenticellate. **Stipules** triangular, *c.* 1.5 × 1 mm. **Leaves** coriaceous, *glabrous above*, *sparsely brown stellate-tomentose below*; *narrowly ovate to lanceolate*, 6.5–11 × 2–3 cm, base acute, rounded or attenuate, margin plane or sometimes revolute, *toothed above the middle*, apex long-acuminate, acumen 10–20(–25) mm long; midrib flat or impressed above, raised below; lateral veins 6–10 pairs, thin and weakly raised on both sides, disappearing near the leaf margin; intercostal venation scalariform, obscure on both surfaces; petiole 5–7 mm long, glabrous. **Inflorescences** male, female or mixed. **Male inflorescences** 7–12 cm long; bracts ovate, 1–2 × 1–1.5 mm; bracteoles reduced to a cluster of hirsute hairs. **Male flowers** solitary but densely arranged along the rachis; perianth lobes obtuse, *c.* 2 × 1 mm; stamens 12, filaments *c.* 3 mm long; pistillode 1–1.5 mm diameter. **Female** or **mixed inflorescences** 8–16 cm long; bracts and bracteoles ovate, 1–2 × 0.7–1.2 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 2.5 × 1 mm; staminodes 12; styles cylindrical, recurved, 1–1.5 mm long. **Cupules** (sub)sessile, asymmetrical, ovoid, 1.2–1.5 × 0.5–0.7(–1.2) cm, densely pubescent, densely spiny; spines up to *c.* 2 mm long, unbranched, flat to triangular, slightly recurved, densely pubescent, sparsely and irregularly or regularly arranged in lines. **Nuts** *1 in each cupule*, ovoid to conical, 1–1.5 × 0.7 cm, free part densely tomentose; *wall thin*, *most part free from the cupule*.

Distribution. India, Burma, China, Taiwan, Thailand, Indo-China, and Malesia (N Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, New Guinea, and New Britain). In Sabah, recorded from Kota Marudu, Keningau and Ranau districts. In Sarawak, uncommon, known only from Sg. Menalio in Marudi district. Not known in Brunei and Kalimantan.

Ecology. In primary lowland mixed dipterocarp forest to montane forest, at 300–2500m altitude.

Uses. The bark yields tannin and the nuts are edible.

2. **Castanopsis borneensis** King Fig. 1.

(of Borneo)

Ann. Bot. Gard. Calc. 2 (1889) 99; Merrill *l.c.* 210; Masamune *l.c.* 152; Soepadmo *l.c.* (1968) 387, *l.c.* (1972) 299; Cockburn *l.c.* (1976) 92; PROSEA *l.c.* 113; Coode *et al.* (eds.) *l.c.* 123; Argent *et al.* (eds.) *l.c.* 238. **Type:** *Beccari PB 1212*, Borneo, Sarawak (holotype FI; isotype K).

Tree up to 20 m tall, 30 cm diameter, *non-coppicing*. **Bark** smooth or slightly fissured, pale brown; inner bark fibrous, yellowish brown. **Sapwood** yellowish. **Twigs** glabrous, slightly fissured or smooth or sparsely lenticellate, grey when young. **Stipules** linear, 2–3.5 mm long. **Leaves** *coriaceous*, *glabrous on both surfaces*; *ovate to elliptic*, *7–11 × 3–5 cm*, *length:width ratio 2–3:1*, base rounded or acute, *margin entire and plane*, apex acuminate, acumen *c.* 10 mm long; midrib raised on both surfaces but stronger below; *lateral veins 6–7 pairs*, thin and flat on both surfaces or sometimes weakly raised below, *joining near the leaf margin*; *intercostal venation dense*, *subscalariform*, *distinct and prominent on both surfaces*; *petiole* 10–15 mm long, *glabrous*. **Inflorescences** male and female. **Male inflorescences** 10–15 cm long; bracts ovate, *c.* 1 mm across; bracteoles lanceolate, *c.* 1 × 0.4 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes acute, *c.* 1.5 × 0.5 mm; stamens 6–8, filaments *c.* 3 mm long; pistillode 1–1.5 mm diameter. **Female inflorescences** *c.* 10 cm long; bracts and bracteoles ovate, 1–1.5 × 0.7 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1 × 0.5 mm; staminodes 12; styles conical, straight, 1–1.5 mm long. **Cupules** sessile, *subglobose*, 1.5–3 × 1–2.5 cm, sparsely pubescent, *densely spiny*; *spines* 5–7 mm long, *unbranched*, *slender*, straight, sparsely pubescent except the tips, densely and irregularly arranged. **Nuts** *1 in each cupule*, ovoid, 1.5–2 × 1–1.5 cm, free apical part sparsely pubescent; *wall thin*, *most part adnate to the cupule*.

Vernacular names. Sarawak—*berangan* (Malay), *berangan padi* (Iban).

Distribution. Endemic to Borneo. In Sabah, common in Ranau, Sipitang and Beaufort districts. In Sarawak, known from Bintulu, Kuching, Miri, and Sibu districts. Also in Brunei.

Ecology. In primary lowland mixed dipterocarp and *kerangas* forests, up to 200 m altitude.

3. **Castanopsis buruana** Miq.

(of Buru Island in Maluku)

Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 120; Soepadmo *l.c.* (1968) 387, *l.c.* (1972) 307; Cockburn *l.c.*

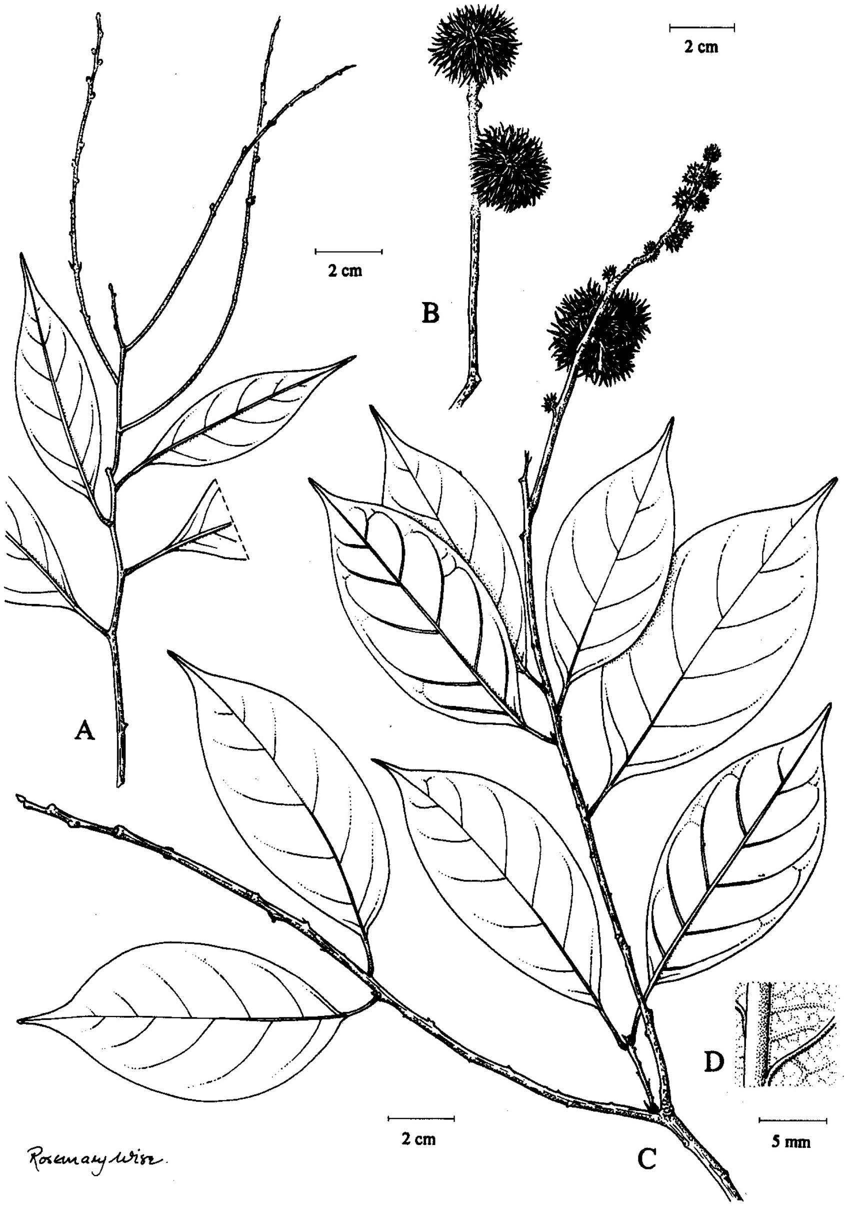

Fig. 1. *Castanopsis borneensis*. A, leafy flowering twig; B, infructescence; C, leafy fruiting twig; D, detail of lower leaf surface. (A from *S. 24588*, B from *S. 23677*, C–D from *S. 46557*.)

(1976) 92; Whitmore, Tantra & Sutisna *l.c.* 152; PROSEA *l.c.* 113. **Type:** *Teijsmann HB 1868*, Maluku, Buru, Kajeli (holotype U; isotypes BO, L). **Synonyms:** *Castanea buruana* (Miq.) Oerst., König. Danske Vid. Selsk. Skr. 5, 9 (1867) 377; *Castanopsis buruana* Miq. forma *grandifolia* Miq. *l.c.* (1863) 120.

Tree up to 30 m tall, 60 cm diameter, *non-coppicing*. **Bark** smooth or sometimes scaly, brown; inner bark reddish or whitish. **Sapwood** white. **Twigs** sparsely stellate-hairy when young, late-glabrescent, *minutely lenticellate*. **Stipules** linear, triangular, 3–4 × 1 mm. **Leaves** coriaceous, glabrous above, *sparsely tomentose below*; *ovate to elliptic*, *(7–)11–13 × 3–4.5 cm*, base cuneate to sometimes acute, *margin entire and revolute*, *apex long-acuminate, acumen c. 20 mm long*; midrib impressed above, raised and sparsely pilose below; lateral veins 8–10 pairs, flat above, thin and weakly raised below, disappearing or sometimes joining near the leaf margin; *intercostal venation lax*, *scalariform*, *weakly raised or almost obscure on both surfaces*; *petiole* 11–18 mm long, *slightly kneed at the base*, glabrous. **Inflorescences** male and female. **Male inflorescences** (4–)7–10 cm long; bracts broadly ovate, 1–1.5 mm across; bracteoles broadly ovate, *c.* 0.5 mm across. **Male flowers** in clusters of 3–4 along the rachis, densely arranged; perianth lobes acute, *c.* 2 × 1 mm; stamens 12, filaments *c.* 3 mm long; pistillode 1–1.5 mm diameter. **Female inflorescences** 10–12 cm long; bracts and bracteoles broadly ovate, *c.* 0.5 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1.5 mm across; staminodes 12, well-developed and exceeding the perianth; styles cylindrical, recurved, 2–2.5 mm long. **Cupules** *subsessile*, *ovoid to conical*, *asymmetrical*, *c. 1.5 × 1 cm*, densely pubescent, spiny; spines 3–5 mm long, unbranched, flat to triangular, straight, sparsely pubescent except the tips, arranged regularly in lines with space in between. **Nuts** *1 in each cupule*, rarely 2, ovoid to globose, 1–1.5 cm across, free apical part densely pilose; *wall thin*, *most part free from the cupule*.

Vernacular name. Sabah—*kogopon* (Dusun, Bundu Tuhan).

Distribution. Borneo, Sulawesi and Maluku. In Sabah, known only from Padang Pentulululungan in Ranau district (two collections) and Kampung Kitau in Keningau district. So far not known in Sarawak, Brunei and Kalimantan.

Ecology. In primary lowland and hill mixed dipterocarp forests, up to 450 m altitude.

4. **Castanopsis clemensii** Soepadmo Fig. 2.

(J. Clemens, 1862–1936, former chaplain of the American Army, plant collector)

Reinwardtia 7 (1968) 388, *l.c.* (1972) 302; Cockburn *l.c.* (1976) 92; Whitmore, Tantra & Sutisna *l.c.* 152. **Type:** *Brand & Anak SAN 25315*, Borneo, Sabah, Ranau district, Sg. Mentaki (holotype L; isotypes K, SAN, SAR).

Tree up to 30 m tall, 50 cm diameter, *non-coppicing*. **Bark** cracked or lenticellate or sometimes smooth, yellowish white; inner bark fibrous, red-brown turning to dirty brown on exposure. **Sapwood** pale yellow. **Twigs** sparsely stellate-hairy, smooth or minute-lenticellate. **Stipules** ovate, *7–9 × 4–5 mm*, *usually persistent*. **Leaves** coriaceous, *glabrous on both surfaces*; *elliptic*, *8–12 × 4–4.5 cm*, base acute, rounded to subcordate, sometimes asymmetrical, *margin entire and plane*, *apex acuminate*, *acumen 8–10 mm long*; midrib faintly raised above, strongly raised below; *lateral veins* 8–10 pairs, flat

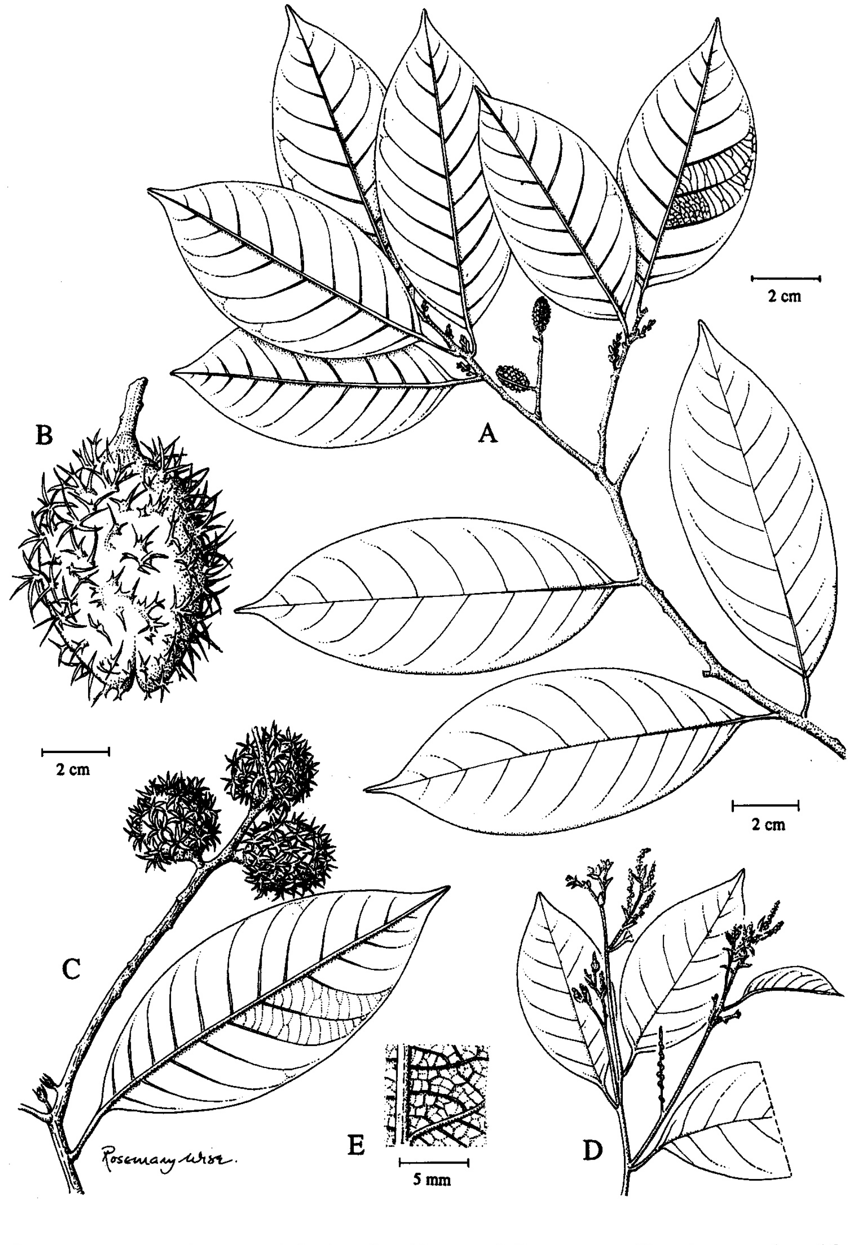

Fig. 2. *Castanopsis clemensii.* A, leafy twig with young infructescence; B, mature cupule and fruit; C, leafy fruiting twig; D, leafy flowering twig; E, detail of lower leaf surface. (A and E from *SAN 94845*, B from *S. 49964*, C from *S. 48679*, D from *S. 44680.*)

above, slightly raised below, *disappearing near the leaf margin*; *intercostal venation dense*, *subscalariform*, *distinctly prominent on both surfaces*; *petiole* 10–12 mm long, *sparsely stellate-pubescent*. **Inflorescences** male and female. **Male inflorescences** 4.5–7 cm long; bracts and bracteoles ovate, *c.* 0.6 mm across. **Male flowers** in clusters of 3–4 along the rachis; perianth lobes obtuse, 1.5–2 mm across; stamens 7–9, filaments *c.* 2 mm long; pistillode *c.* 1.5 mm diameter. **Female inflorescences** 4–7.5 cm long; bracts broadly ovate, *c.* 1.5 × 1 mm; bracteoles ovate, *c.* 1 × 0.5 mm. **Female flowers** solitary along the rachis; perianth lobes acute, 0.5–1 mm across; staminodes 12; styles cylindrical, recurved, 1–1.5 mm long. **Cupules** *obovoid or ellipsoid*, 1.3–2.5 × 1–1.5 cm, sparsely puberulous, *spiny except for the adaxial and abaxial sutures*; stalk *c.* 0.5 cm long; spines 5–8 mm long, branched at the base or sometimes unbranched, flat, straight, sparsely pubescent, sparsely and irregularly arranged. **Nuts** *1 in each cupule*, ellipsoid, 1–2 × 1.5 cm, free apical part pubescent; *wall thin*, *most part adnate to the cupule*.

Vernacular name. Sabah—*kogopon* (Dusun).

Distribution. Endemic to Borneo. In Sabah, common in Ranau district and recorded by a few collections from Tenom, Tambunan and Keningau districts. In Sarawak, reported from Bario, Limbang (G. Murut) and Sri Aman districts. Not known in Brunei and Kalimantan.

Ecology. In primary lower montane forest, up to 1300 m altitude.

5. **Castanopsis costata** (Blume) A. DC.

(Latin, *costatus* = ribbed; the prominent lateral veins)

J. Bot. 1 (1863) 182; Merrill *l.c.* 210; Masamune *l.c.* 232; Burkill *l.c.* 493; Soepadmo *l.c.* (1968) 388, *l.c.* (1972) 312; Cockburn *l.c.* (1972) 203, *l.c.* (1976) 89 & 90; Whitmore, Tantra & Sutisna *l.c.* 152; PROSEA *l.c.* 113; Turner *l.c.* 234; Coode *et al.* (eds.) *l.c.* 124; Argent *et al.* (eds.) *l.c.* 238. **Basionym:** *Castanea costata* Blume, Mus. Bot. Lugd.-Bat. 1 (1850) 284. **Type:** *Korthlas s.n.* (= *RHL Sheet No. 901309120*), Sumatra, Bt. Melintang (holotype L). **Synonyms:** *Castanea brevicuspis* Miq., Fl. Ind. Bat. 1, 1 (1858) 866; *Castanopsis brevicuspis* (Miq.) A. DC. *l.c.* 182; *Castanea spectabilis* Miq. *l.c.* 866; *Castanopsis spectabilis* (Miq.) A. DC. *l.c.* 182; *Castanopsis trisperma* Scheff, Nat. Tijd. Ned. Ind., 31 (1870) 362.

Tree up to 36 m tall, 80 cm diameter, *non-coppicing*. **Bark** smooth or scaly or sometimes flaky, whitish; inner bark fibrous, yellowish. **Sapwood** pale yellow. **Twigs** pubescent when young, glabrescent, *sparsely minute-lenticellate*. **Stipules** linear, triangular, 5–8 × 1 mm. **Leaves** coriaceous to sometimes thick-coriaceous, *glabrous above*, *sparsely to densely rusty brown stellate-tomentose* or very rarely glabrous *below*; elliptic-oblong or ovate, (8–)11–15(–19) × 3–6.5 cm, base abruptly acute to rounded, *margin entire*, *slightly to strongly revolute*, *apex acute*; midrib flat above, strongly raised below; *lateral veins* 8–15 pairs, *distantly spaced*, impressed above, raised below, disappearing near the leaf margin; intercostal venation scalariform, obscure or sometimes prominent above, slightly prominent below; petiole (6–)10–15(–25) mm long, sparsely stellate-hairy. **Inflorescences** male and female. **Male inflorescences** 9–13.5 cm long; bracts and bracteoles ovate, 1–1.5 × 1 mm. **Male flowers** in clusters of 2–3 or sometimes solitary along the rachis; perianth lobes acute, *c.* 1.5 × 0.5 mm; stamens 12, filaments 2–2.5 mm long; pistillode 1–1.5 mm diameter. **Female inflorescences** 6.5–12 cm long; bracts and bracteoles broadly ovate, *c.* 1–2 × 1 mm. **Female flowers** in clusters of 3 or sometimes solitary along the rachis; perianth lobes acute, *c.* 1 × 1 mm; staminodes 12; styles cylindrical, slightly recurved, 1–1.5 mm long. **Cupules** subglobose, 1–2.5 × 1.5–2.5 cm, densely pubescent, dehiscing into 4 segments, spiny; *stalk 0.5–0.7 cm long*; spines 7–12 mm long, branched, rarely unbranched, slender, strongly recurved, sparsely hairy at the base, densely and irregularly arranged. **Nuts** *2–3 in each cupule*, conical, 1–2 × 1–1.5 cm, *free part densely pubescent*; *wall thin*, *most part free from the cupule*.

Distribution. Sumatra, Peninsular Malaysia, Java, and Borneo. Common and widely distributed in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary lowland mixed dipterocarp forest to montane forest, up to 1900m altitude.

Uses. The timber is locally used for house-building. The nuts are edible.

6. **Castanopsis densinervia** Soepadmo

(Latin, *densus* = dense, *nervia* = nerves; densely veined, the leaves)

Reinwardtia 7 (1968) 389, *l.c.* (1972) 301; Cockburn *l.c.* (1976) 89; Whitmore, Tantra & Sutisna *l.c.* 152; PROSEA *l.c.* 114; Argent *et al.* (eds.) *l.c.* 238. **Type:** *Meijer SAN 48109*, Borneo, Sabah, Mt. Kinabalu, west of Mesilau Cave (holotype L; isotypes K, SAN).

Tree up to 30 m tall, 50 cm diameter, *non-coppicing*. **Bark** smooth, greyish; inner bark greyish turning to dark grey on exposure. **Sapwood** dark grey on exposure. **Twigs** *sparsely covered with large lenticels*, sparsely stellate-hairy or glabrous. **Leaves** thick-coriaceous, *glabrous and shining above*, *densely brown tomentose or pilose below*; *ovate or elliptic-oblong*, 9.5–12.5 × 3–4.5 cm, base acute, rounded to subcordate, sometimes asymmetrical, *margin entire and revolute*, *apex acute or shortly acuminate*, *acumen c. 5 mm long*; midrib flat or impressed above, raised below; *lateral veins* 12–15 pairs, *closely spaced and parallel*, impressed above, strongly raised below, disappearing near the leaf margin; intercostal venation dense, scalariform, obscure above, faintly prominent below; petiole 10–15 mm long, sparsely stellate-hairy. **Inflorescences** male and female. **Male inflorescences** 3–7 cm long; bracts ovate, 1–1.5 mm across; bracteoles lanceolate, *c.* 0.7 × 0.3 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes acute, 1.5–2 mm across; stamens 12, filaments *c.* 2.5 mm long; pistillode 2–3 mm diameter. **Female inflorescences** 3–4 cm long; bracts and bracteoles ovate, 1–1.5 mm across. **Female flowers** solitary along the rachis; perianth lobes obtuse, *c.* 0.5 × 0.5 mm; staminodes 12; styles conical, straight, 2–2.5 mm long. **Cupules** subglobose, 2.5–4.5 × 2–4 cm, glabrous, spiny except for a small part of the adaxial suture; *stalk c. 0.5 cm long*; spines 7–10 mm long, branched at the base, slender, straight, sparsely pubescent at the base, densely but irregularly arranged with space in between. **Nuts** *1 in each cupule*, ovoid, *c.* 3.5 × 3 cm, *free apical part glabrous*; *wall thin*, *most part adnate to the cupule.*

Distribution. Endemic to Borneo. In Sabah, recorded mainly from Mt. Kinabalu in

Ranau and Kimanis road in Keningau districts; so far no record from Sarawak. Also in NE Kalimantan.

Ecology. In primary hill mixed dipterocarp forest to lower montane forest, at 1000–1800 m altitude.

7. **Castanopsis endertii** Hatus. *ex* Soepadmo

(F.H. Endert, 1891–1953, sometime officer of the Indonesia Forestry Service, Java)

Reinwardtia 7 (1968) 390, *l.c.* (1972) 301; Whitmore, Tantra & Sutisna *l.c.* 152; Argent *et al.* (eds.) *l.c.* 238. **Type:** *Endert 5196*, Borneo, Kalimantan, W Kutai, Kombeng (holotype L; isotype BO).

Tree up to 35 m tall, 60 cm diameter, *non-coppicing*. **Bark** smooth with ring-like markings, slightly fissured, brownish; inner bark granular, greyish. **Sapwood** yellowish. **Twigs** glabrous, *smooth*. **Stipules** linear, triangular, 4–6 × 2 mm. **Leaves** thin-coriaceous, *glabrous on both surfaces*; *elliptic to oblong*, (10.5–)13–18(–23) × (5–)6–8(–10) cm, base rounded or acute, *margin entire and plane*, apex acute to shortly acuminate, acumen *c.* 5 mm long; midrib slightly raised above, stronger below; *lateral veins* (7–)10–12 pairs, flat above, raised below, *disappearing near the leaf margin*; *intercostal venation lax*, *scalariform*, *faintly prominent on both surfaces*; petiole (10–)10–15(–25) mm long, glabrous. **Inflorescences** male and female. **Male inflorescences** 10–12 cm long; bracts ovate. **Male flowers** in clusters of 3 along the rachis; perianth lobes acute, 1–1.5 mm across; stamens 12, filaments 2–2.5 mm long; pistillode *c.* 2 mm diameter. **Female inflorescences** 8–12 cm long; bracts and bracteoles ovate, 1–2 × 0.5–1 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1.5 mm across; staminodes 12; styles conical, straight, *c.* 1.5 mm long. **Cupules** *subsessile*, globose, *c.* 2.5–4 cm across, sparsely pubescent, spiny; *spines* 7–13 mm long, *unbranched*, sturdy, straight or slightly recurved, sparsely pubescent, sparsely and irregularly arranged. **Nuts** *1 in each cupule*, globose, 2–3.5 cm across; *wall thin*, *most part adnate to the cupule*.

Vernacular name. Sabah—*kogopon* (Dusun).

Distribution. Endemic to Borneo. Widely distributed throughout Sabah; so far not known in Brunei and Sarawak. Also in Kalimantan.

Ecology. In primary and disturbed montane forests, up to 2500 m altitude.

Use. The nuts are edible.

8. **Castanopsis evansii** Elmer

(J.H. Evans, former Governor of Puerto Princesa, Palawan, the Philippines)

Leafl. Philip. Bot. 5 (1913) 1778; Soepadmo *l.c.* (1968) 391, *l.c.* (1972) 305; Cockburn *l.c.* (1976) 92; Whitmore, Tantra & Sutisna *l.c.* 153; Kessler & Sidiyasa *l.c* 138; PROSEA *l.c.* 114. **Type:** *Elmer 12988*, the Philippines, Palawan, Mt. Pulgar (holotype A; isotypes K, L, NY, U, US, WRSL). **Synonyms:** *Castanopsis woodii* Merr., Philip. J. Sc. 29 (1926) 362; *Castanopsis elmeri* Merr., PEB (1929) 42.

Tree up to 20 m tall, 30 cm diameter, *non-coppicing*. **Bark** smooth or sometimes flaky, greyish; inner bark fibrous, yellow. **Sapwood** pale yellow. **Twigs** glabrous, *sparsely minute-lenticellate*. **Stipules** linear, triangular, 5–6 × 2 mm. **Leaves** coriaceous rarely thick-coriaceous, *glabrous on both surfaces*; *elliptic to lanceolate*, 11–17 × 4–6 cm, base attenuate, acute to rounded, *margin entire and revolute*, apex acute; midrib slightly raised above, stronger below; *lateral veins* 11–14 pairs, flat above, raised below, *joining near the leaf margin*; *intercostal venation lax*, *scalariform*, *thin and faintly prominent on both surfaces*; petiole (6–)12–20 mm long, glabrous. **Inflorescences** male, female or mixed. **Male inflorescences** (3.5–)8–12 cm long; bracts and bracteoles ovate, 1–1.5 × 0.7–1 mm. **Male flowers** solitary or sometimes in clusters of 3 along the rachis; perianth lobes obtuse, 1–1.5 mm across; stamens 10–12, filaments *c.* 2.5 mm long; pistillode *c.* 1.5 mm diameter. **Female** and **mixed inflorescences** 6–10 cm long; bracts and bracteoles broadly ovate, *c.* 1 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1.5 mm across; staminodes 12; styles conical, recurved, 1–2 mm long. **Cupules** subglobose, obovoid to ellipsoid, 3–4.5 × 3–4 cm, glabrous or sometimes pubescent, spiny; *stalk c. 0.5 mm long*; *spines* 7–19 mm long, *much-branched*, slender, straight, glabrous, sparsely and irregularly arranged. **Nuts** *1 in each cupule*, ovoid, 3–3.5 cm across, free apical part densely tomentose; *wall thin*, *most part adnate to the cupule*.

Vernacular names. Sabah—*buling* (Dusun, Banggi), *kumpat* (Dusun, Rungus).

Distribution. Borneo and the Philippines. Common throughout Sabah; in Sarawak rare, only known by one collection from G. Gading FR in Lundu district (*S. 9645*). Also in SE Kalimantan.

Ecology. In primary and disturbed hill mixed dipterocarp forest, up to 500 m altitude.

9. **Castanopsis foxworthyi** Schottky Fig. 3.

(F.W. Foxworthy, 1877–1950, botanist of the Bureau of Science, Manila and later research officer at the Forest Department of Malay Peninsula)

Bot. Jahrb. 49 (1913) 358; Merrill *l.c.* (1921) 211; Masamune *l.c.* 232; Soepadmo *l.c.* (1968) 391, *l.c.* (1972) 309; Cockburn *l.c.* (1976) 92; Anderson *l.c.* 198; Whitmore *l.c.* 153; PROSEA *l.c.* 114; Turner *l.c.* 234; Coode *et al.* (eds.) *l.c.* 124. **Type:** *Foxworthy 214 (n.v.),* Borneo, Sarawak. **Synonym:** *Castanopsis kinabaluensis* A. Camus, Bull. Soc. Bot. Fr. 75 (1928) 698.

Tree up to 30 m tall, 60 cm diameter, *non-coppicing*. **Bark** smooth, blackish brown; inner bark pale red. **Sapwood** yellowish white. **Twigs** sparsely stellate-pubescent, large-lenticellate or sometimes finely fissured. **Stipules** narrowly ovate to elliptic, 6–8 × 1–2 mm. **Leaves** *thick-coriaceous*, *glabrous on both surfaces*; *elliptic or lanceolate*, *7–12(–16.5) × 4–7.5 cm*, base attenuate, rounded or acute, *margin entire and revolute*, apex acuminate, acumen *c.* 10 mm long; midrib slightly raised above, stronger below; *lateral veins 7–12 pairs*, impressed above, flat or sometimes raised below, *disappearing near the leaf margin*; *intercostal venation dense*, *scalariform*, *prominent on both surfaces*; *petiole* (8–)10–15(–18) mm long, *glabrous*. **Inflorescences** male and female. **Male inflorescences** 7–15 cm long; bracts and bracteoles ovate, *c.* 1 × 0.5 mm. **Male flowers** in clusters of 3 along the rachis, perianth lobes acute, *c.* 2 × 1.5 mm; stamens 12,

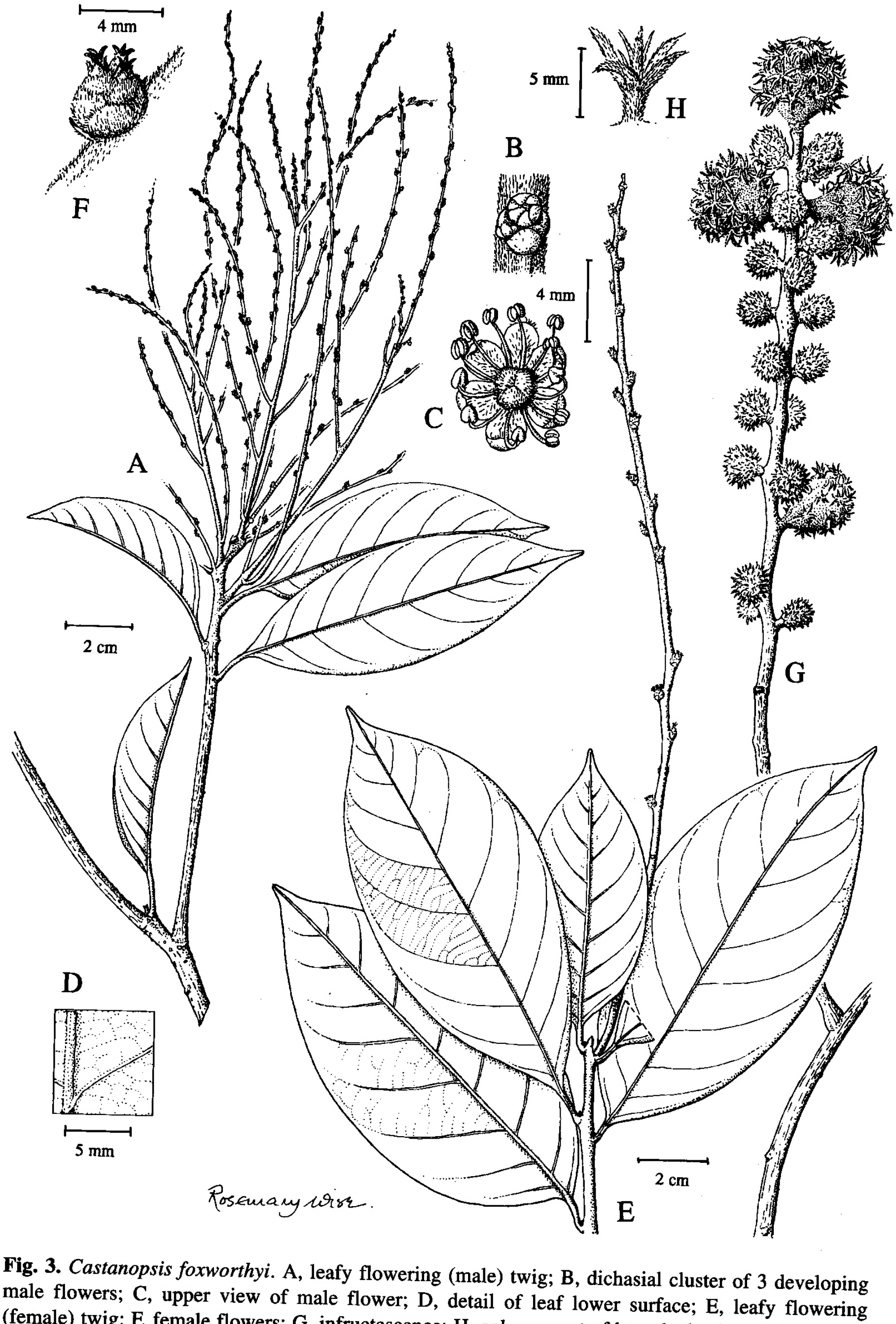

Fig. 3. *Castanopsis foxworthyi.* A, leafy flowering (male) twig; B, dichasial cluster of 3 developing male flowers; C, upper view of male flower; D, detail of leaf lower surface; E, leafy flowering (female) twig; F, female flowers; G, infructescence; H, enlargement of branched spine of the cupule. (A–D from *S. 33009*, E–F from *S. 47090*, G–H from *S. 47089*.)

filaments *c.* 2.5 mm long; pistillode *c.* 5 mm diameter. **Female inflorescences** 8–10 cm long; bracts ovate, *c.* 1 × 0.5 mm; bracteoles broadly ovate, *c.* 1 mm across. **Female flowers** in clusters of 3 along the rachis; perianth lobes acute, *c.* 1 mm across; staminodes 12; styles conical, straight, *c.* 1 mm long. **Cupules** *subglobose*, 3–5 × 2–3 cm, densely pubescent, *sparsely spiny*; stalk *c.* 0.5 cm long; *spines c.* 6 mm long, *branched at the base*, *flat to triangular*, straight, sparsely pubescent at the base, *sparsely and regularly arranged with space in between*. **Nuts** *3 in each cupule*, ovoid, 1–2 cm across, free part densely hairy; *wall thin*, *most part free from the cupule*.

Vernacular names. Sarawak—*berangan lingkau* (Iban), *berangan paya* (Malay); *beluing*, *maruwit* (Tagar).

Distribution. NE Sumatra, Peninsular Malaysia, Singapore, and Borneo. Very common and widely distributed in Sabah and Sarawak. Also in Brunei.

Ecology. In primary mixed dipterocarp, peatswamp and *kerangas* forests, to montane forest, up to 2100 m altitude.

10. **Castanopsis fulva** Gamble

(Latin, *fulvus* = tawny; the indumentum)

Kew Bull. (1914) 179; Soepadmo *l.c.* (1968) 391, *l.c.* (1972) 312; Cockburn *l.c.* (1972) 204, *l.c.* (1976) 89; Anderson *l.c.* 198; Whitmore, Tantra, Sutisna *l.c.* 153; PROSEA *l.c.* 114; Turner *l.c.* 234; Coode *et al.* (eds.) *l.c.* 124; Argent *et al.* (eds.) *l.c.* 240. **Lectotype** (Soepadmo 1968)**:** *King's Collectors 7751*, Peninsular Malaysia, Perak, Batang Padang (holotype K; isotypes L, SING).

Tree up to 25 m tall, 50 cm diameter, *non-coppicing*. **Bark** smooth or slightly fissured; inner bark granular, red-brown. **Sapwood** creamy yellow. **Twigs** velvety hairy or sometimes glabrescent, *finely fissured*. **Stipules** triangular, 2–3 × 1 mm. **Leaves** *thick-coriaceous*, *glabrous above*, *sparsely to densely brown stellate-hairy below*; *elliptic*, *ovate*, *to oblong*, *11–17 × 4–7 cm*, base acute, attenuate or rounded, *margin entire and revolute*, *apex long-acuminate*, *acumen 10–15 mm long*; midrib flat above, strongly raised below; *lateral veins* 8–13 pairs, flat above, raised below, *disappearing near the leaf margin*; intercostal venation scalariform, weakly prominent above, stronger below; *petiole* 12–25 mm long, *strongly kneed at the base,* densely stellate-hairy. **Inflorescences** male, female or mixed. **Male inflorescences** (5–)11–14.5 cm long; bracts ovate, 1.5–2 × 1–1.5 mm; bracteoles ovate, 0.5–1 mm across. **Male flowers** in clusters of 3 along the rachis; perianth lobes acute, 1–1.5 × 1 mm; stamens 12, filaments 1–1.5 mm long; pistillode 1.5–2 mm diameter. **Female** and **mixed inflorescences** 9–11(–18) cm long; bracts and bracteoles broadly ovate, 1.5–2 mm across. **Female flowers** in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 0.5 mm across; staminodes 12; styles cylindrical, straight, *c.* 1 mm long. **Cupules** *subglobose*, *2.5–3 × 2–2.5 cm*, densely pubescent, spiny; *stalk c. 0.5 cm long*; *spines c.* 5 mm long, much-branched, *slender*, slightly recurved or straight, pubescent except the tips, sparsely to densely and *irregularly arranged*. **Nuts** *3 in each cupule but only 1 well-developed*, ovoid-conical, 1.5–2 cm across, free part pubescent; *wall thin*, *most part free from the cupule*.

Vernacular name. Sarawak—*berangan padi* (Iban).

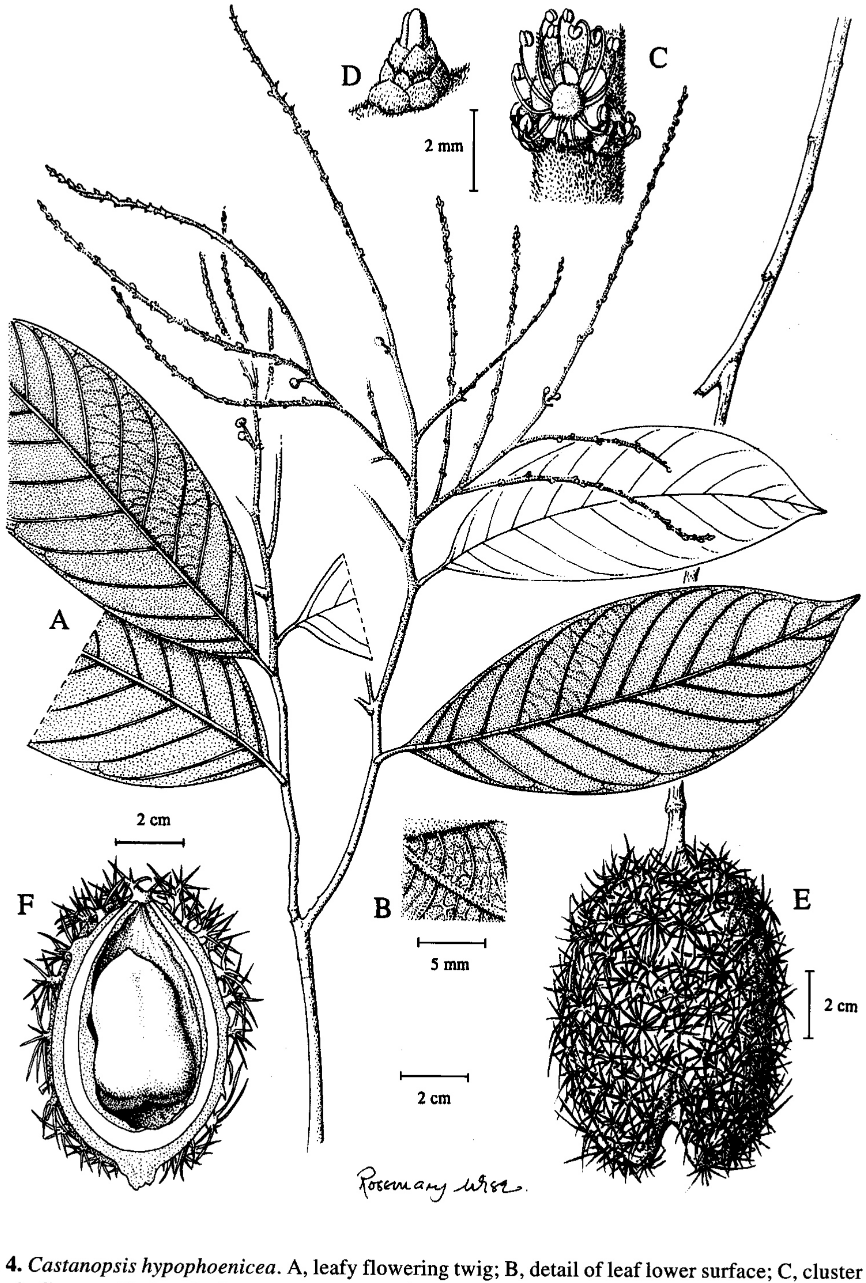

Fig. 4. *Castanopsis hypophoenicea*. A, leafy flowering twig; B, detail of leaf lower surface; C, cluster of male flowers; D, female flowers; E, mature cupule; F, longitudinal section of mature cupule and fruit. (A–B from *SAN 83755*, C from *SAN 93191*, D from *SAN 83755*, E from *SAN 40481*, F from *SAN 22507*.)

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Beaufort and Ranau districts. In Sarawak, common and widely distributed. Also in Kalimantan and Brunei.

Ecology. In primary hill mixed dipterocarp and *kerangas* forests, up to 1100 m altitude.

11. **Castanopsis hypophoenicea** (Seemen) Soepadmo Fig. 4.

(Latinised Greek, *hypophoeniceus* = purple-red or crimsom beneath; the indumentum of lower leaf surface)

Reinwardtia 7 (1968) 392, *l.c.* (1972) 305; Cockburn *l.c.* (1976) 93; Anderson *l.c.* 198; Whitmore, Tantra & Sutisna *l.c.* 153; PROSEA *l.c.* 115; Coode *et al.* (eds.) *l.c.* 153; Argent *et al.* (eds.) *l.c.* 240. **Basionym:** *Quercus hypophoenicea* Seemen, Bot. Jahrb. 23, Beibl. 57 (1897) 52. **Type:** *Beccari PB 2287,* Borneo, Sarawak (holotype FI; isotypes K, L, P). **Synonyms:** *Lithocarpus hypophoenicea* (Seemen) Barn., Trans. & Proc. Bot. Soc. Edinb. 44 (1944) 171; *C. dipersispina* Merr., PEB (1929) 41.

Tree up to 30 m tall, 60 cm diameter, *non-coppicing*. **Bark** rough or sometimes smooth, greyish; inner bark fibrous, pale yellow to reddish. **Sapwood** yellowish white. **Twigs** glabrous to sometimes densely yellowish brown pubescent with hirsute and stellate hairs, *sparsely minute-lenticellate*. **Stipules** ovate, 6–8 × 4–5 mm. **Leaves** coriaceous, rarely thick-coriaceous, *glabrous above*, *sparsely to densely covered with appressed stellate and hirsute hairs below*; *elliptic*, *oblong or ovate-lanceolate*, *10–17 × 4–7 cm*, base rounded, acute, to attenuate, asymmetrical, *margin entire and slightly revolute*, *apex long-acuminate*, *acumen c. 15 mm long*; midrib impressed above, raised below; lateral veins 11–12 pairs, flat or impressed above, raised below, joining near the leaf margin; *intercostal venation dense*, *scalariform*, *prominent on both surfaces*, stronger below; *petiole* 7–17 mm long, *slightly kneed at the base*, densely covered with stellate and hirsute hairs. **Inflorescences** male, female or mixed. **Male inflorescences** (5–)8.5–11 cm long; bracts and bracteoles ovate to lanceolate, 0.7–1 × 0.7 mm. **Male flowers** in clusters of 3–5 along the rachis; perianth lobes obtuse, 1–1.5 mm across; stamens 10, filaments *c.* 1.5 mm long; pistillode 1.5–2 mm diameter. **Female** and **mixed inflorescences** *c.* 11.5 cm long; bracts and bracteoles ovate, *c.* 1 × 0.5 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1 mm across; staminodes 10; styles conical, recurved, *c.* 1.5 mm long. **Cupules** *subsessile*, *ovoid to ellipsoid*, *7–10 × 4.5–7 cm*, puberulous, spiny; spines 12–22 mm long, much-branched, slender, straight or recurved, pubescent or sometimes glabrous, sparsely and irregularly arranged with space in between. **Nuts** *1 in each cupule*, ovoid to ellipsoid, 4–6 × 3–5 cm, free apical part glabrous; *wall woody and thick*, *most part adnate to the cupule*.

Vernacular names. Sabah—*pedayang* (Dusun). Sarawak—*berangan bo* (Iban), *wau* (Bidayuh). Brunei—*bedayang* (Dusun), *beranang* (Malay).

Distribution. Endemic to Borneo. Widely distributed throughout Sabah. In Sarawak, common in Kapit, Kuching and Sarikei districts. Also in Brunei and Kalimantan.

Ecology. In primary and secondary hill mixed dipterocarp forests, up to 800 m altitude.

12. **Castanopsis javanica** (Blume) A. DC. Fig. 5.

(of Java)

J. Bot. 1 (1863) 182; Merrill *l.c.* (1921) 211; Masamune *l.c.* 233; Soepadmo *l.c.* (1968) 393, *l.c.* (1972) 306; Cockburn *l.c.* (1972) 205, *l.c.* (1976) 90; Anderson *l.c.* 198; Whitmore, Tantra & Sutisna *l.c.* 153; PROSEA *l.c.* 115; Turner *l.c.* 234. **Basionym:** *Fagus javanica* Blume, Flora 7 (1824) 295. **Type:** *Blume s.n.* (= *RHL Sheet No. 901309128*), Java, Tjibeureum, Mt. Gede (holotype L). **Synonyms:** *Castanea javanica* (Blume) Blume, Bijdr. Fl. Ned. Ind. (1825) 525; *Castanea ?montana* Blume *l.c.* (1825) 526; *Castanea javanica* Blume var. *montana* (Blume.) Blume, Fl. Javae Cupul. (1829) 45, *t.* 24; *Castanea javanica* (Blume) Blume var. *fuscescens* (Blume) Blume *l.c.* (1829) 45; *Castanopsis javanica* (Blume) A. DC. var. *montana* (Blume) A. DC., Prod. 16, 2 (1864) 111; *Quercus discocarpa* Hance, J. Bot. 12 (1874) 242; *Quercus javanica* (Blume) Drake, J. Bot. 4 (1890) 153; *Castanopsis lentiginosa* E.F. Warb., Kew Bull. (1936) 20; *Castanopsis penangensis* A. Camus, Bull. Soc. Bot. Fr. 94 (1947) 4.

Tree up to 40 m tall, 100 cm diameter, *non-coppicing*. **Bark** smooth or scaly, brown; inner bark laminated, brown. **Sapwood** greyish white. **Twigs** glabrous, *densely covered with large lenticels*. **Stipules** linear, triangular, *c.* 5 × 2 mm. **Leaves** coriaceous, *glabrous above*, *sparsely tomentose below*; *ovate to elliptic*, (7–)11–13(–15) × (2.5–)3.5–5 cm, base attenuate, rounded, or acute, *margin entire and slightly revolute*, *apex acuminate*, *acumen 10–15 mm long*; midrib flat or impressed above, raised below; lateral veins 8–12 pairs, impressed above, slightly raised below, disappearing near the leaf margin; intercostal venation dense, scalariform, obscure above, thin and weakly prominent below; *petiole (4–)6–8(–12) mm long*, sparsely pilose. **Inflorescences** male, female or mixed. **Male Inflorescences** 4.5–7 cm long; bracts broadly ovate, 1–1.5 mm across; bracteoles ovate, *c.* 1 × 0.5 mm. **Male flowers** in clusters of 2–3 along the rachis; perianth lobes acute, *c.* 1.5 × 1 mm; stamens 12; filaments *c.* 1 mm long; pistillode 1–1.5 mm diameter. **Female** and **mixed inflorescences** 6–10 cm long; bracts ovate, 2–2.5 × 1–1.5 mm; bracteoles broadly ovate, *c.* 0.5 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1 mm across; staminodes 8; styles cylindrical, straight, 2–3 mm long. **Cupules** *discoid*, *asymmetrical*, *0.7–1.5 × 1–1.5 cm*, densely pubescent, *spiny*; *stalk slender and straight*, 0.5–1 cm long; *spines 2–3 mm long*, branched at the base, *flat to triangular or sometimes slender*, *straight*, pubescent except the tips, sparsely arranged in regular lines with spaces in between. **Nuts** *1 in each cupule*, discoid or depressed ovoid, 1–1.5 × 2–2.5 cm, free part hairy; *wall thin*, *most part free from the cupule*.

Vernacular name. Sarawak—*kupat* (Kelabit).

Distribution. Sumatra, Peninsular Malaysia, W Java, and Borneo. In Sabah, known from Keningau, Penampang, Tenom and Ranau districts. In Sarawak, common in Bario, Kapit, and Marudi districts. So far not known in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp forest, up to 1000 m altitude.

Uses. The timber is widely used by local people for house-building (e.g house post). The bark has tanning properties, and the nuts are edible.

13. **Castanopsis lucida** (Nees *in* Wall.) Soepadmo

(Latin, *lucidus* = shining; the upper leaf surface)

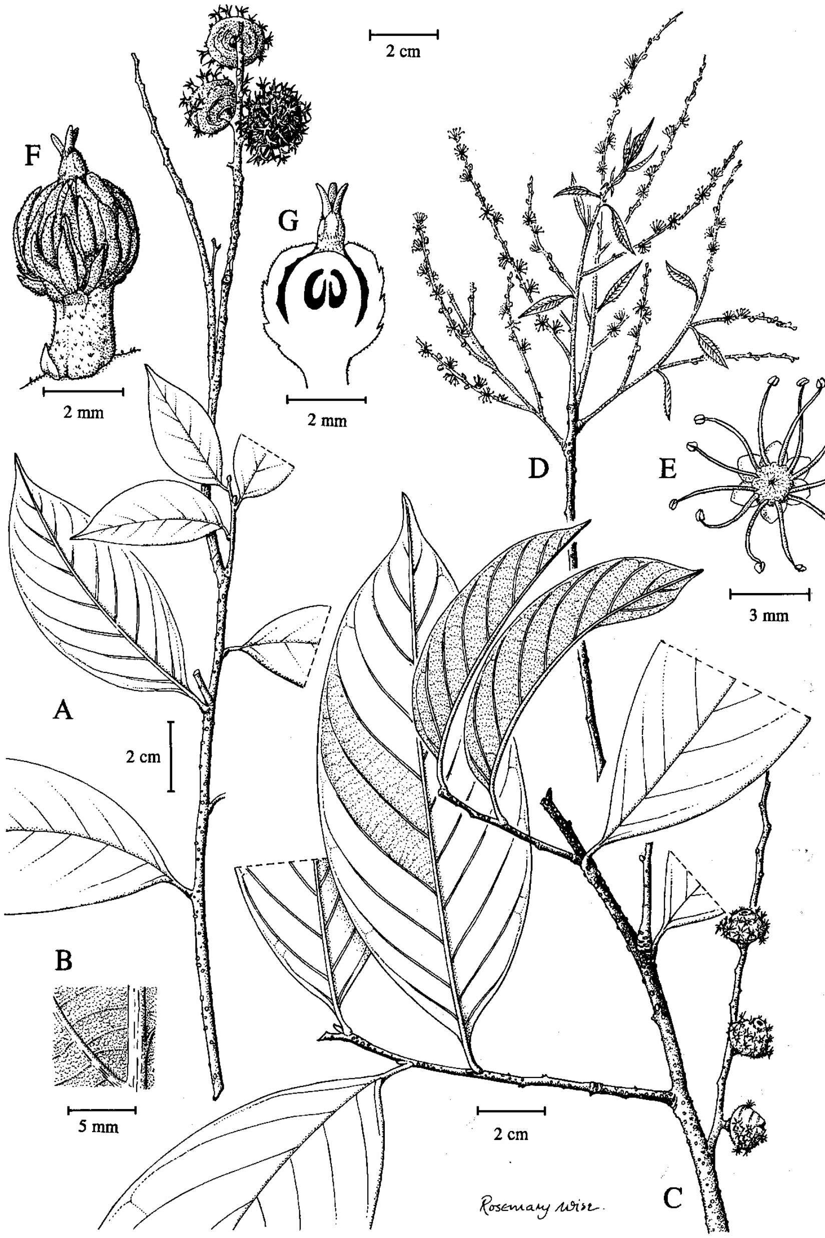

Fig. 5. *Castanopsis javanica.* A, leafy fruiting twig; B, detail of lower leaf surface; C, leafy twig with young infructescence; D, flowering new shoots; E, male flower; F, female flower; G, longitudinal section of female flower. (A–B from *SAN 117874*, C from *SAN 20998*, D–G from *van Balgooy 5183.*)

Reinwardtia 7 (1968) 394, *l.c.* (1972) 318; Cockburn *l.c.* (1972) 205; Whitmore, Tantra & Sutisna *l.c.* 153; PROSEA *l.c.* 115; Turner *l.c.* 243; Argent *et al.* (eds.) *l.c.* 240. **Basionym:** *Alseodaphne lucida* Nees *in* Wall., Pl. As. Rar. 2 (1831) 72. **Type:** *Wallich 2590* (under the name of *Laurus lucida*), Singapore (BM, K). **Synonym:** *C. hullettii* King *ex* Hook. *f.*, Fl. Br. Ind. 5 (1888) 623.

Tree up to 20 m tall, 40 cm diameter, *non-coppicing*; buttresses up to 1.6 m tall, straight. **Bark** glabrescent, large-lenticellate or fissured or rarely smooth, brown; inner bark fibrous, yellowish brown. **Sapwood** dirty white. **Twigs** sparsely stellate-hairy, *densely covered with large lenticels*. **Stipules** triangular, *c.* 2 × 1 mm. **Leaves** thick-coriaceous, *glabrous and shining above*, *sparsely pubescent below*; *elliptic*, *oblong to ovate-elliptic*, (10–)16–21(–26) × (3.5–)8–10 cm, base rounded, sometimes attenuate or acute, *margin entire and revolute*, *apex obtuse*; midrib broad and raised on both surfaces, stronger below; lateral veins 13–18 pairs, parallel, flat above, strongly raised below, disappearing near the leaf margin; intercostal venation dense, scalariform, thin and weakly prominent on both surfaces; *petiole 20–35 mm long*, densely stellate-hairy. **Inflorescences** male and female. **Male inflorescences** 10–15 cm long; bracts and bracteoles ovate, 0.5–1 × 0.5–1 mm. **Male flowers** in clusters of 3–5 along the rachis; perianth lobes obtuse, 1–1.5 × 0.5–1 mm; stamens 12, filaments 2.5–3 mm long; pistillode 1–1.5 mm diameter. **Female inflorescences** 8–10 cm long; bracts broadly ovate, *c.* 1.5 mm across; bracteoles ovate, *c.* 1 mm across. **Female flowers** in clusters of 3 along the rachis; perianth lobes acute, *c.* 0.5 mm across; staminodes 12; styles conical, straight, 0.5–1 mm long. **Cupules** *depressed subglobose*, asymmetrical, *2.5–4 cm diameter*, sparsely pubescent, *shortly spiny or tubercled*, dehiscing into 3–4 equal segments; *stalk thick and twisted*, *c.* 0.5 cm long; spines or tubercles 2–3 mm long, unbranched, flat to triangular, recurved, sturdy, sparsely tomentose, sparsely and regularly arranged in lines. **Nuts** *2–4 in each cupule*, ovoid, 1.5–2 cm across, free part glabrous; *wall thick and woody*, *most part free from the cupule*.

Distribution. Peninsular Malaysia, Singapore and Borneo. So far, not known from Sabah. In Sarawak uncommon, known only by one collection (*Beccari PB 3242*) from Marop. Also in Kalimantan.

Ecology. In hill mixed dipterocarp forest, up to 500 m altitude.

Uses. The bark yields tannin and the nuts are edible.

14. **Castanopsis megacarpa** Gamble

(Greek, *mega* = large, *karpos* = fruit; with large fruit)

Kew Bull. (1914) 180; Burkill *l.c.* 494; Soepadmo *l.c.* (1968) 395, *l.c.* (1972) 305; Cockburn *l.c.* (1972) 206, *l.c.* (1976) 90; Anderson *l.c.* 198; Whitmore, Tantra & Sutisna *l.c.* 153; PROSEA *l.c.* 115; Turner *l.c.* 234; Argent *et al.* (eds.) *l.c.* 240. **Type:** *King's Collectors 7070*, Peninsular Malaysia, Perak, Kinta (holotype K; isotype L).

Tree up to 36 m tall, 90 cm diameter, *non-coppicing*. **Bark** smooth or shallowly fissured, grey; inner bark fibrous, yellow. **Sapwood** white or pale yellow. **Twigs** sparsely tomentose or sometimes glabrous, *sparsely lenticellate or sometimes smooth*. **Stipules** ovate, *c.* 5 × 2 mm. **Leaves** thick-coriaceous, glabrous and shining above, *sparsely brownish tomentose* *below*; *elliptic-oblong*, (15–)20–24(–30) × 7.5–8.5(–10) cm, base rounded, attenuate or acute, sometimes asymmetrical, *margin entire and strongly revolute*, *apex acute*; *midrib* impressed above, *broad and strongly raised below*; *lateral veins 13–15 pairs*, flat above, raised below, disappearing near the leaf margin; intercostal venation scalariform, prominent on both surfaces; petiole 12–25 mm long, sparsely stellate-hairy. **Inflorescences** male and female. **Male inflorescences** (6–)8–14(–17) cm long; bracts broadly ovate, *c.* 1 mm across; bracteoles ovate, *c.* 1 × 0.5 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 1.5 × 1 mm; stamens 12, filaments 2–2.5 mm long; pistillode *c.* 2 mm diameter. **Female inflorescences** 9–12 cm long; bracts and bracteoles ovate, 2–2.5 × 1–1.5 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1.5 × 1 mm; staminodes 12; styles conical, straight, *c.* 0.5 mm long. **Cupules** *sessile*, ellipsoid or globose, *5–8 × 3–5.5 cm*, pubescent, spiny; spines 15–20 mm long, branched, sturdy, recurved or straight, sparsely or densely and irregularly arranged. **Nuts** *1 in each cupule*, ellipsoid or globose, 3–7.5 × 3–4.5, *free apical part glabrous*; *wall thick and woody*, *most part adnate to the cupule*.

Distribution. Peninsular Malaysia, Singapore and Borneo. In Sabah, known from Sipitang, Beaufort and Ranau districts. In Sarawak, known from Bintulu, Kuching and Lundu (G. Pueh) districts. Also in Kalimantan.

Ecology. In primary and secondary mixed dipterocarp, *kerangas* to lower montane forests, up to 1400 m altitude.

Uses. The timber is used locally for making bowls and other domestic utensils.

15. **Castanopsis microphylla** Soepadmo

(Greek, *mikro* = small, *phullon* = leaf; small-leaved)

Reinwardtia 7 (1968) 395, *l.c.* (1972) 310; Anderson *l.c.* 198; Whitmore, Tantra & Sutisna *l.c.* 153; PROSEA *l.c.* 116. **Type:** *Sibat S. 22511*, Borneo, Sarawak, Tatau district, Anap, Bt. Mersing (holotype K; isotypes A, BO, KEP, L, SAN, SAR, SING).

Tree up to 30 m tall, 60 cm diameter, *non-coppicing*. **Bark** smooth or sometimes flaky; inner bark fibrous, yellow. **Sapwood** yellowish. **Twigs** sparsely pubescent, *smooth*. **Stipules** linear, triangular, *c.* 3 × 1 mm. **Leaves** coriaceous, glabrous above, *sparsely tomentose below*; *linear to lanceolate*, *5–8 × 1.5–2.5 cm*, base rounded, acute or attenuate, *margin entire and plane*, *apex long-acuminate*, *acumen c. 15 mm long*; midrib raised on both surfaces; lateral veins 8–9 pairs, flat above, raised below, disappearing near the leaf margin; intercostal venation scalariform, obscure above, weakly prominent below; petiole *c.* 5 mm long, sparsely pilose. **Inflorescences** male, female or mixed. **Male inflorescences** (3–)6–12 cm long; bracts and bracteoles ovate, *c.* 1 × 0.5 mm. **Male flowers** in clusters of 3–4 along the rachis; perianth lobes acute, *c.* 1.5 mm across; stamens 12, filaments 1–1.5 mm long; pistillode *c.* 0.5 mm diameter. **Female** and **mixed inflorescences** (4.5–)8.5–11 cm long; bracts ovate, *c.* 1 × 0.5 mm; bracteoles subrotundate, *c.* 0.5 mm across. **Female flowers** in clusters of 2–3 along the rachis; perianth lobes acute, *c.* 2.5 × 1 mm; staminodes 12; styles conical, recurved, *c.* 1 mm long. **Cupules** (sub)globose, asymmetrical, 2–3 × 1.5–3 cm, densely tomentose, shortly spiny or tubercled; stalk grooved, 0.5–2 cm long; spines 2–3 mm long, unbranched, flat to triangular, strongly recurved, sparsely pubescent at the base, arranged regularly or sometimes irregularly in lines with space in between. **Nuts** *2–3 in each cupule*, *equally developed*, ovoid, 1–1.5 cm across, free part sparsely pubescent; *wall thin*, *most part free from the cupule*.

Vernacular name. Sabah—*kogopon* (Dusun, Kinabatangan).

Distribution. Endemic to Borneo. In Sabah known from Ranau, Beaufort and Kinabatangan districts. In Sarawak known from Kapit, Kuching, Mukah, and Tatau districts. Also in Kalimantan.

Ecology. In lowland mixed dipterocarp forest to lower montane forest, up to 1600 m altitude.

16. **Castanopsis motleyana** King Fig. 6.

(James D. Motley, ?–1859, engineer and plant collector, mainly in Borneo)

Ann. Bot. Gard. Calc. 2 (1889) 96; Merrill *l.c.* (1921) 211; Masamune *l.c.* 233; Soepadmo *l.c.* (1968) 396, *l.c.* (1972) 314; Cockburn *l.c.* (1976) 93; Anderson *l.c.* 198; Whitmore, Tantra & Sutisna *l.c.* 153; Kessler & Sidiyasa *l.c.* 138; PROSEA *l.c.* 116; Coode *et al.* (eds.) *l.c.* 124; Argent *et al.* (eds.) *l.c.* 240. **Type:** *Beccari PB 2613*, Borneo, Sarawak (holotype FI; isotypes K, P). **Synonym:** *C. pearsonii* Merr., Philip J. Sc. 30 (1920) 79.

Tree up to 40 m tall, 70 cm diameter, *non-coppicing*; buttresses spreading, up to 4 m tall. **Bark** vertically cracked or scaly, reddish or chocolate-brown; inner bark fibrous, brown. **Sapwood** white. **Twigs** densely rusty brown pubescent when young, glabrescent, *smooth*. **Stipules** ovate, 7–10 × 2.5–3 mm. **Leaves** thick-coriaceous, glabrous above, *densely pubescent below*, glabrescent; *obovate*, *rarely elliptic-oblong*, (9–)15–25(–27) × (5–)7–11 cm, base acute to attenuate, *margin entire and strongly revolute*, *apex short-acuminate*, *acumen c. 5 mm long*; *midrib* prominent above, *broad and strongly raised below*; *lateral veins 10–13 pairs*, flat above, strongly raised below, joining near the leaf margin; intercostal venation scalariform, obscure above, slightly to strongly prominent below; petiole 8–20 mm long, glabrous or sparsely hairy. **Inflorescences** male, female or mixed. **Male inflorescences** (4–)7.5–13 cm long; bracts and bracteoles ovate, *c.* 1 × 0.5 mm. **Male flowers** in dense clusters of 3 along the rachis; perianth lobes acute, 1–1.5 mm across; stamens 12, filaments 2–3 mm long; pistillode 1.5–2.5 mm diameter. **Female** and **mixed inflorescences** 10–17 cm long; bracts and bracteoles ovate, 1–1.5 × 0.5 mm. **Female flowers** in clusters of 2–3 along the rachis; perianth lobes obtuse, *c.* 5 mm across; staminodes 12; styles cylindrical, straight, 1–1.5 mm long. **Cupules** *sessile*, subglobose, *2–3 × 1.5–2.5 cm*, closely arranged together along the rachis; densely pubescent, *spiny*; spines 7–15 mm long, branched at least at the base, slender, straight, densely pubescent except the tips, densely and irregularly arranged. **Nuts** *2–3 in each cupule*, ovoid to conical, 1.5–2.5 × 1.5–2 cm, *sparsely pilose at the apex*; *wall thin*, *most part free from the cupule.*

Vernacular names. Sabah—*babayi* (Rungus). Sarawak—*berangan daun besar* (Malay).

Distribution. Borneo and the Philippines. In Sabah and Sarawak common and widely distributed. Also in Brunei and Kalimantan.

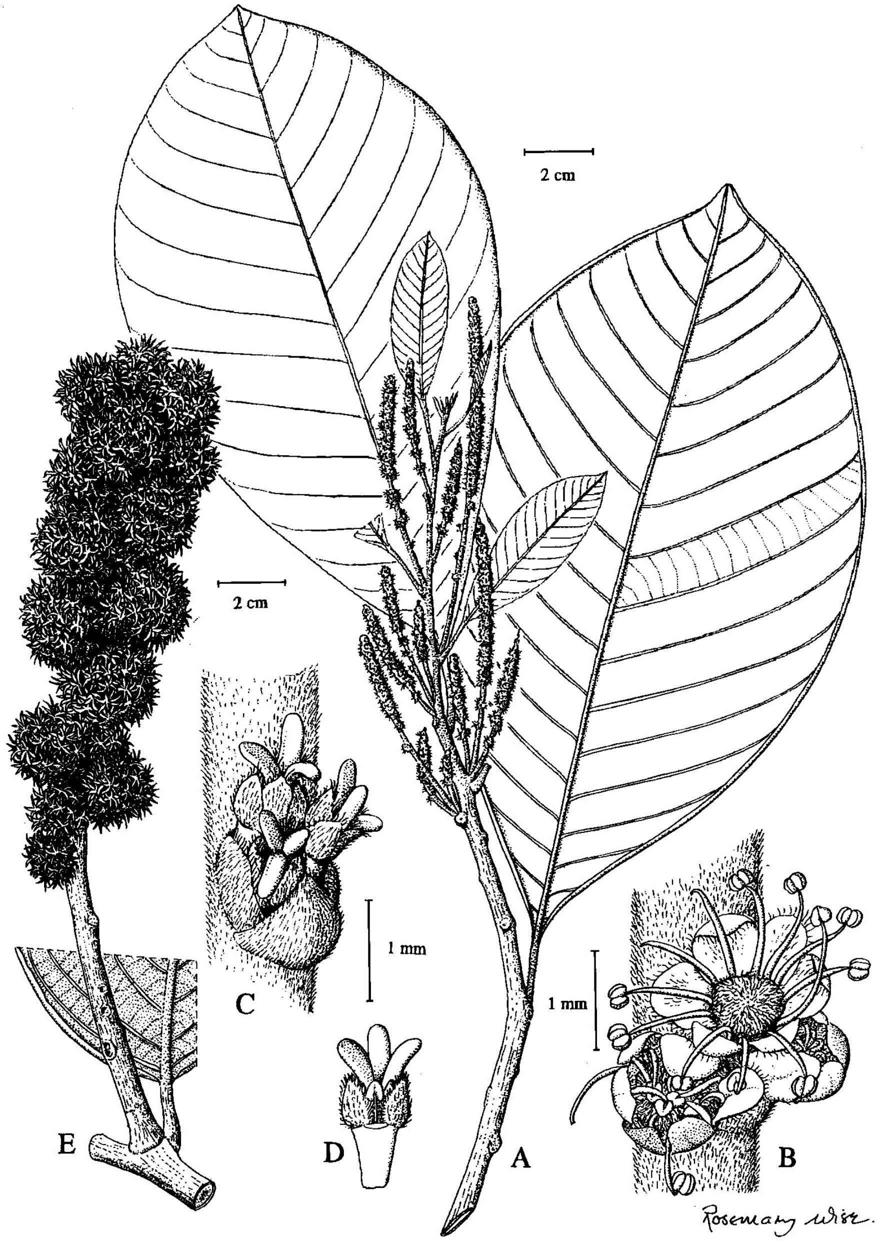

Fig. 6. *Castanopsis motleyana.* A, leafy flowering twig; B, cluster of male flowers; C, cluster of female flowers; D, female flower with one of the perianth lobes removed; E, infructescence. (A–D from *SAN 68309*, E from *S. 46883*.)

Ecology. In hill mixed dipterocarp forest, up to 500 m altitude.

17. **Castanopsis oligoneura** Soepadmo

(Greek, *oligo* = few, *neuron* = nerves or veins; the few-veined leaves)

Reinwardtia 7 (1968) 397, *l.c.* (1972) 300; Cockburn *l.c.* (1976) 94; Anderson *l.c.* 198; Whitmore, Tantra & Sutisna *l.c.* 154; Coode *et al.* (eds.) *l.c.* 124. **Type:** *Meijer SAN 32836*, Borneo, Sabah, Sandakan district, Sibuga Road, Kebun China FR (holotype L; isotypes K, SAN, SAR, SING).

Tree up to 25 m tall, 45 cm diameter, *non-coppicing*. **Bark** smooth or sometimes lenticellate, brownish; inner bark fibrous, light brown. **Sapwood** white. **Twigs** glabrous, *smooth or sometimes sparsely minute-lenticellate*. **Stipules** ovate, 3–4 × 1 mm. **Leaves** thick-coriaceous, glabrous above, *sparsely brownish tomentose below*; *ovate or elliptic*, (7.5–)13–15 × 3–5(–6.5), base acute to attenuate, *margin entire and slightly revolute*, *apex acute or short-acuminate*, *acumen c. 5 mm long*; *midrib thin*, flat above, raised below; *lateral veins 5–7 pairs*, flat above, raised below, joining near the leaf margin; intercostal venation scalariform, weakly prominent on both surfaces; petiole 12–22 mm long, glabrous. **Inflorescences** male, female or mixed. **Male inflorescences** (5–)7–10 cm long; bracts ovate, 1–1.5 × 0.7 mm; bracteoles ovate, *c.* 0.7 × 0.4 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes ovate, acute, *c.* 1.5 × 1 mm; stamens 12, filaments 3–4 mm long; pistillode *c.* 1 mm diameter. **Female** and **mixed inflorescences** 10–13 cm long; bracts and bracteoles ovate, *c.* 2 × 1 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1.5 mm across; staminodes 12; styles cylindrical, recurved, 1–2 mm long. **Cupules** *subsessile*, subglobose, 2–3 × 2–2.5 cm, sparsely pubescent, spiny; spines 6–9 mm long, unbranched, slender, straight or sometimes recurved, pubescent, sparsely and irregularly arranged. **Nuts** *1 in each cupule*, subglobose, 2–2.5 × 2 cm, free apical part sparsely to densely hairy; *wall woody and thick*, *most part adnate to the cupule*.

Distribution. Endemic to Borneo. In Sabah, known from a few collections from Sandakan, Beaufort and Sipitang districts. In Sarawak, known only from Ulu Baleh in Kapit district and Bungoh Range in Bau district. Also in Brunei.

Ecology. In lowland mixed dipterocarp forest, up to 300 m altitude.

18. **Castanopsis oviformis** Soepadmo

(Latin, *ovum* = egg; *formis* = shaped; the egg-shaped cupule)

Reinwardtia 7 (1968) 397, *l.c.* (1972) 302; Cockburn *l.c.* (1976) 94; Anderson *l.c.* 198; Whitmore, Tantra & Sutisna *l.c.* 154; Kessler & Sidiyasa *l.c.* 138; PROSEA *l.c.* 116; Argent *et al.* (eds.) *l.c.* 242. **Type:** *Sibat S. 23233,* Borneo, Sarawak, Mukah district, Balingian, Ulu Arip, Bt. Iju (holotype L; isotypes A, BO, K, SAN, SAR, SING).

Tree up to 30 m tall, 50 cm diameter, *non-coppicing*; buttresses small, sometimes branched. **Bark** cracked or scaly, brownish; inner bark granular, pale brown. **Sapwood** yellowish. **Twigs** pubescent when young, late-glabrescent, minutely lenticellate. **Stipules** *caducous*, ovate, *3–5 × 2–3 mm*. **Leaves** coriaceous, *glabrous on both surfaces*; *elliptic*, *oblong* *or ovate*, *7–14 × 4–6.5 cm*, base rounded to acute, sometimes asymmetrical, *margin entire and revolute*, *apex short-acuminate*, *acumen c. 5 mm long*; midrib flat above, raised below; *lateral veins* 9–13 pairs, flat above, slightly raised below, *joining near the leaf margin*; *intercostal venation dense*, *scalariform*, *prominent on both surfaces*; *petiole* 8–15 mm long, *sparsely hairy*. **Inflorescences** male, female or mixed. **Male inflorescences** (5–)7–11 cm long; bracts and bracteoles ovate, 1.5–2 × 1–1.5 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 1 mm across; stamens 12, filaments 1.5–2 mm long; pistillode *c.* 1.5 mm diameter. **Female** and **mixed inflorescences** 4.5–8 cm long; bracts and bracteoles broadly ovate, *c.* 1 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1 mm across; staminodes 12; styles cylindrical, straight, *c.* 2 mm long. **Cupules** *ovoid*, *obovoid or ellipsoid*, 2–5 × 1.5–3 cm, sparsely pubescent, *spiny except the abaxial and adaxial sutures*; stalk 0.5–1 cm long; spines 2–5 mm long, unbranched, flat to triangular, straight or recurved, sparsely hairy at the base, sparsely and regularly arranged. **Nuts** *1 in each cupule*, ovoid, 2–2.5 × 1–1.5 cm, free apical part glabrous; *wall woody*, *thick*, *most part adnate to the cupule*.

Vernacular names. Sarawak—*berangan pipit* (Iban), *butoh terampayoh*, *terampayoh* (Kelabit).

Distribution. Endemic to Borneo. Common and widely distributed throughout Sabah and Sarawak. Also in Kalimantan.

Ecology. In primary hill mixed dipterocarp and *kerangas* forests, up to 900 m altitude.

Use. The nuts are edible though somewhat bitter.

19. **Castanopsis paucispina** Soepadmo

(Latin, *pauci* = few or sparse, *spina* = spines; the sparsely spined cupule)

Reinwardtia 7 (1968) 398, *l.c.* (1972) 301; Anderson *l.c.* 198; Whitmore, Tantra & Sutisna *l.c.* 154; Kessler & Sidiyasa *l.c* 139; PROSEA *l.c.* 116. **Type:** *Wood & Wyatt-Smith SAN A 4385*, Borneo, Sabah, 1/2 mile east of Tambunan, Keningau district (holotype L; isotypes A, BRI, KEP, SAN, SING).

Tree up to 30 m tall, 60 cm diameter, *non-coppicing*. **Bark** smooth or slightly cracked, brown; inner bark fibrous. **Twigs** densely brownish stellate-tomentose, *sparsely minute-lenticellate*. **Stipules** ovate, *c.* 2 × 1 mm. **Leaves** *thin-coriaceous*, glabrous above, *sparsely to densely pubescent below*; *ovate-lanceolate or elliptic*, *8–14 × 3.5–5 cm*, base rounded to acute, *margin entire and plane*, *apex long-acuminate*, *rarely acute*, *acumen c. 10 mm long*; midrib impressed above, raised below; *lateral veins* 8–10 pairs, flat above, raised below, *joining near the leaf margin*; intercostal venation scalariform, weakly prominent on both surfaces; *petiole* 10–17 mm long, *strongly kneed at the base*, sparsely stellate-hairy. **Inflorescences** male and female. **Male inflorescences** 4–6.5 cm long; bracts and bracteoles ovate, *c.* 1 × 0.5 mm. **Male flowers** in clusters of 2–3 along the rachis; perianth lobes acute, *c.* 2 × 1 mm; stamens 10–12, filaments 2.5–3.5 mm long; pistillode *c.* 1.5 mm diameter. **Female inflorescences** 5–10 cm long; bracts and bracteoles ovate, *c.* 1 × 0.5–1 mm. **Female flowers** solitary along the rachis; perianth lobes ovate, acute, *c.* 1 × 0.5–1 mm; staminodes 12; styles conical, straight, 1–1.5 mm long. **Cupules** *obovoid to ellipsoid*, *4–4.5 × 3–3.5 cm*, glabrous or rarely sparsely pubescent, spiny; *stalk 0.5–*

1 cm long; *spines* 5–7 mm long, unbranched, *sturdy*, *flat to triangular*, glabrous, *sparsely but regularly arranged in 3–4 rows except on the adaxial suture*. **Nuts** *1 in each cupule*, obovoid to subglobose, *c*. 4 × 3 cm, free apical part glabrous; *wall woody*, *thick*, *most part adnate to the cupule*.

Vernacular name. Sarawak—*saled* (Kelabit).

Distribution. Endemic to Borneo (except Brunei and Kalimantan). In Sabah recorded for Trus Madi FR in Tambunan district and in Penampang district. In Sarawak, known only from Marudi and Tatau districts.

Ecology. In hill mixed dipterocarp forest, up to 1100 m altitude.

20. **Castanopsis pedunculata** Soepadmo

(Latin, *pedunculatus* = provided with a peduncle; the long-stalked cupule)

Reinwardtia 7 (1968) 399, *l.c.* (1972) 315; Cockburn *l.c.* (1976) 90; Whitmore, Tantra & Sutisna *l.c.* 154. **Type:** *Wood SAN 16805*, Borneo, Sabah, Sipitang district, Mile 6, southeast of Malaman, Ulu Mendalong (holotype L; isotypes K, KEP, SAN, SING).

Tree up to 25 m tall, 40 cm diameter, *non-coppicing*; buttresses up to 2 m tall. **Bark** flaky or lenticellate, brown. **Twigs** *glabrous*, *densely to sparsely lenticellate*. **Leaves** coriaceous, *glabrous on both surfaces*; *elliptic to oblong*, *12–14 × 3–5 cm*, base rounded or acute, *margin entire and plane*, apex short-acuminate, acumen *c*. 5 mm long; midrib impressed above, slightly raised below; *lateral veins* 9–10 pairs, flat above, raised below, *joining near the leaf margin*; *intercostal venation dense*, *subscalariform*, *prominent on both surfaces*, stronger below; *petiole 15–20 mm long*, glabrous. **Inflorescences** and **flowers** unknown. **Cupules** obovoid or subglobose, 2–3.5 × 1.5–2.5 cm, sometimes asymmetrical, densely tomentose, *almost smooth*; *stalk 1–1.5 cm long*. **Nuts** *3 in each cupule*, ovoid, 1.5–2 cm across, free part sparsely puberulous; *wall thin*, *most part free from the cupule*.

Vernacular name. Sarawak—*berangan* (Iban, Malay).

Distribution. Endemic to Borneo (except Brunei and Kalimantan). In Sabah, known by the type specimen from Ulu Mendalong in Sipitang district (*SAN 16805*), whereas in Sarawak known only by a single collection from Similajau FR in Bintulu district (*Burley & Lee 235*).

Ecology. In lowland mixed dipterocarp forest, up to 300 m altitude.

21. **Castanopsis psilophylla** Soepadmo Fig. 7.

(Greek, *psilos* = smooth, *phullon* = leaves; the smooth leaf surface)

Reinwardtia 7 (1968) 401, *l.c.* (1972) 315; Cockburn *l.c.* (1976) 95; Anderson *l.c.* 198; Whitmore, Tantra & Sutisna *l.c.* 154; PROSEA *l.c.* 116; Argent *et al.* (eds.) *l.c.* 242. **Type:** *Muin SAN 25953*, Borneo, Sabah, Lahad Datu district, Kalumpang, Sg. Limau (holotype L; isotypes K, SAN, SAR).

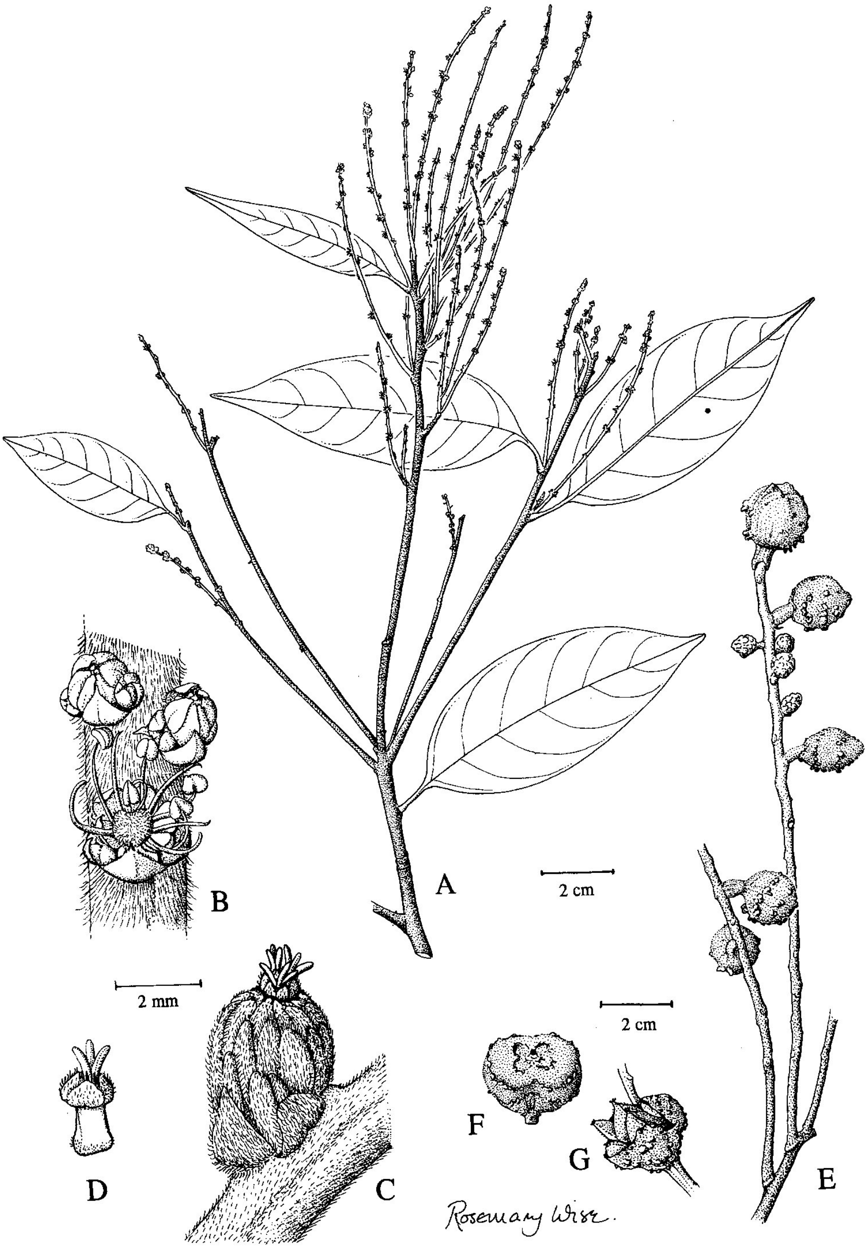

Fig. 7. *Castanopsis psilophylla*. A, leafy flowering twig; B, part of male inflorescence; C, cluster of 3 female flowers enclosed by a developing cupule; D, female flower; E, infructescence; F, cupule; G, dehiscing cupule showing 5 developed fruits. (A–D from *SAN 132641*, E from *Nooteboom & Chai 2320*, F from *SAN 16780*, G from *SAN 21412*.)

Tree up to 30 m tall, 50 cm diameter, *non-coppicing*. **Bark** smooth or finely fissured, brown; inner bark brownish. **Sapwood** yellowish or whitish. **Twigs** *glabrous*, *smooth*. **Stipules** linear, 3–4 mm long. **Leaves** thin-coriaceous, *glabrous on both surfaces*; *ovate*, *lanceolate or elliptic*, *8–15 × 2.5–4.5 cm*, base rounded, acute or cuneate, *margin entire and plane*, apex acuminate, acumen 5–20 mm long; midrib flat or sometimes impressed above, raised below, glabrous; *lateral veins* 6–10 pairs, flat above, weakly raised below, *disappearing near the leaf margin*; *intercostal venation dense*, *subscalariform*, *prominent on both surfaces*; *petiole 8–13 mm long*, glabrous. **Inflorescences** male, female or mixed. **Male inflorescences** (4–)6–8(–10) cm long; bracts and bracteoles ovate, *c.* 1 × 0.5 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 1 mm across; stamens 9, filaments *c.* 2 mm long; pistillode *c.* 1 mm diameter. **Female** and **mixed inflorescences** 6–8 cm long; bracts and bracteoles broadly ovate, 1–2 mm across. **Female flowers** in clusters of 3–4 along the rachis; perianth lobes acute, *c.* 1 mm across; staminodes 12; styles conical, recurved, *c.* 1 mm long. **Cupules** pear-shaped, asymmetrical, 1.5–3 × 1.5–2 cm, dehiscing irregularly into 4 segments, densely golden tomentose all over, *covered with several ridges of short tubercles*; *subsessile or with stalk 0.5–1 cm long*. **Nuts** *3–5 in each cupule*, *but only one well-developed*, asymmetrical, ovoid, 1.5–2 cm across, free part pubescent; *wall thin*, *most part free from the cupule.*

Vernacular names. Sabah—*mengarung* (Dusun), *tukalod*, *kogopon* (Dusun, Kinabatangan). Sarawak—*berangan entadu* (Iban).

Distribution. Borneo, the Philippines and Banguey Island. Common and widely distributed in Sabah. In Sarawak, known only from Limbang and Marudi districts. Also in Kalimantan.

Ecology. In primary and secondary hill mixed dipterocarp forests, up to 1000 m altitude.

Use. The nuts are edible.

2. **LITHOCARPUS** Blume

(Greek, *lithos* = stone, *karpos* = fruit; the hard and woody cupule and acorn)

empenit, *mempening* (Malay); *empili* (Iban); *salad* and variants (Kayan, Kelabit, Kenyah, Melanau, Murut, Punan); *tekulud* (Dusun)

Bijdr. Fl. Ned. Ind. (1825) 526; Rehder, J. Arn. Arb. 1 (1919) 122, *ibid*. 10 (1929) 132; Warburg, Kew Bull. 20 (1936) 19; Barnett, Trans. & Proc. Bot. Soc. Edinb. 33 (1942) 332; Soepadmo, Reinwardtia 8 (1970) 197, FM 1, 7 (1972) 318; Cockburn, TFM 1 (1972) 209, TS 1 (1976) 95; Anderson, CLTS (1980) 199; Corner, WSTM 3rd. edition 1 (1988) 331; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 154; Kubitzki *in* Kubitzki *et al.* (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 307; Turner, Gard. Bull. Sing. 47, 1 (1995) 235; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area, East Kalimantan (1994) 139; PROSEA 5, 2 (1995) 284; Coode *et al.* (eds.), CLBD (1996) 124; Kochummen, TFPF (1997) 246; Argent *et al.* (eds.), MNDT-CK 1 (1997) 242. **Synonyms:** *Synaedrys* Lindl., Introd. Nat. Syst. ed. 3 (1836) 441; *Cyclobalanus* (Endl.) Oerst., Vid. Medd. Naturch. For. Kjöbn. 8 (1867) 80; *Pasania* (Miq.) Oerst., *ibid*. 81.

Trees, rarely shrubs; buttresses or stilt-roots occasionally present. *Wood rays narrow-uniseriate and broad-multiseriate*. **Bark** smooth or fissured, often lenticellate; inner bark granular or fibrous, *with ridges protruding into the sapwood*. **Twigs** glabrous or hairy, lenticellate or smooth. **Stipules** *extrapetiolar*, small, caducous. *Terminal bud solitary*. **Leaves** *spirally arranged*, *margin entire*; *petiole stout*, *thickened throughout its length*. **Inflorescences** *erect*, male, female, androgynous or mixed, densely simple- and stellate-pubescent. **Male inflorescences** in lateral or subterminal, lax to dense, paniculate clusters on the new shoots or solitary in the axils of lower (proximal) leaves; bracts and bracteoles small, caducous. **Male flowers** *solitary or in dichasial clusters of 3–7(–24) along the rachis* or in an androgynous inflorescence along the upper parts of the rachis; perianth 6–lobed; stamens (10–)12, filaments filiform, glabrous; *anthers dorsifixed*, *reniform*; *pistillode well developed*, (sub)globose, densely woolly pubescent. **Female, androgynous** or **mixed inflorescences** solitary in the axils of upper (distal) leaves or on the upper parts of paniculate clusters or terminal on the new shoots; bracts and bracteoles usually bigger and thicker than those of male inflorescences, persistent. **Female flowers** *solitary or in dichasial clusters of 2–10 along the rachis*, or in an androgynous inflorescence along the basal parts of the rachis; perianth 6–lobed; *staminodes (10–)12*, rudimentary; styles 3, conical or cylindrical, straight or recurved, densely hairy at the base, *stigmas minute, terminal and punctiform*. **Cupules** *solitary or in dichasial clusters of 2–10 along the rachis*, *partly or completely enclosing a solitary nut*, *indehiscent*, *scaly*, *muricate*, *tuberculate*, *almost smooth or lamellate with the lamellae adpressed to the external cupule wall*. **Fruits** (acorns) *rounded in cross-section*, sometimes falsely multi-septate by intrusions of the endocarp; wall woody or bony, most part adnate or free from the cupule. Seed germination hypogeal.

Distribution. About 300 species, mainly in the tropics and subtropics of NE India (Nepal, Bhutan, Assam), Burma, China, Korea, Japan, Formosa, Hainan, Indo-China, Thailand, and Malesia (except for the eastern parts of Java and the Lesser Sunda Islands). One species, *Lithocarpus densiflorus*, occurs in the SW parts of the United States. In Sabah and Sarawak, the genus is represented by 61 species.

Ecology. In lowland to montane forests, from sea level up to 3000 m altitude, more commonly below 1500 m, on different types of soils, including limestone substrate.

Uses. The timber is locally used for medium to heavy constructions but preservative treatment is a prerequisite for permanent structures. The wood is suitable for manifacturing pulp and paper, and the bark contains tannin. Round wood and branches of several species are used as bed logs in mushroom cultivation. The nuts of several species are edible.

Key to *Lithocarpus* species

1. Leaves sessile……………………………………………………**58. L. tawaiensis**
   Leaves distinctly petioled……………………………………………………2

2. Most part of acorn wall adnate to the cupule……………………………………3
   Most part of acorn wall free from the cupule……………………………………13

3. Cupule scaly, muricate, echinate, echinulate or tuberculate……………………4
   Cupule lamellate……………………………………………………………6

4. Leaves thin-coriaceous, base rounded to acute. Cupule obovoid or pear-shaped, stalk 5–20 mm long……………………………………………...………**52. L. rotundatus**
Leaves thick-coriaceoaus or coriaceous, base acute to cuneate. Cupule obconical, sessile or with short stalk up to 5 mm long……………………..............………………………...5

5. Intercostal venation scalariform, thin but clearly visible below; lateral veins dense. Cupule tuberculate, with an opening 1.5–4 cm diameter at the apex...........**47. L. pulcher**
Intercostal venation subscalariform, obscure on both surfaces or slightly prominent below; lateral veins lax. Cupule armed with recurved prickles or spine-like appendages, with an opening *c.* 1 cm diameter at the apex……………............…...**18. L. echinifer**

6. Leaves glabrous or sparsely tomentose above, glabrous or sparsely to densely appressed tomentose below…………………………………….……………..…………….7
Leaves densely appressed tomentose on both surfaces or glabrous above and densely appressed tomentose below..……………………...……………………..………...9

7. Leaves 15–24 × 7–10 cm; petiole 15–30 mm long. Cupule obovoid to subglobose……
…………………...……………………………………….…...……….**25. L. hallieri**
Leaves 6–16 × 3–6 cm; petiole 5–15 mm long. Cupule obconical, ovoid or ellipsoid…8

8. Cupule obconical. Intercostal venation dense; midrib raised on both surfaces, stronger above……………………………………………....……..……………**15. L. corneri**
Cupule ovoid to ellipsoid. Intercostal venation lax; midrib slightly raised above, strongly raised below……………………………...........................……..**53. L. ruminatus**

9. Cupule much longer than broad, turbinate, ellipsoid or obovoid……..………………..10
Cupule almost as long as broad, subglobose or depressed globose………….………..12

10. Intercostal venation dense. Cupule obovoid, strongly lamellate, lamellae raised and folded inwards, longitidunally grooved…………………….…...…...**31. L. keningauensis**
Intercostal venation usually lax. Cupule turbinate to ellipsoid, smooth, lamellae not strongly raised, edge minutely denticulate or entire…………………..……………...11

11. Apex of cupule with an opening 0.5–1 cm diameter. Leaves thick-coriaceous, rigid; lateral veins clearly joining near the leaf margin……….……………..**59. L. turbinatus**
Cupule without an opening at the apex. Leaves coriaceous, lateral veins faintly joining or disappearing near the leaf margin……….…..……………………**3. L. beccarianus**

12. Leaves thick-coriaceous, sometimes rigid, 11–15.5 cm long, apex acuminate, acumen 5– 12 mm long; lateral veins dense. Cupule smooth………………...…..**30. L. kalkmanii**
Leaves coriaceous, not rigid, 16–25 cm long, apex obtuse to short-acuminate, acumen up to 5 mm long; lateral veins lax. Cupule ridged…………….…………**45. L. porcatus**

13. Most part of acorn enclosed by the cupule………………........................………14
Most part of acorn exserted…..…………………………...…………………………..20

14. Lateral veins clearly joining near the leaf margin……………………………………...15
Lateral veins disappearing or faintly joining near the leaf margin……………………16

15. Leaves broadly ovate or elliptic-oblong; lateral veins lax, forming an angle of 60–80° with the midrib. Cupule with a stalk *c*. 5 mm long; appendages hook-like, recurved. Acorn ovoid to subglobose…….………………..…………………...**6. L. brochidodromus**
    Leaves narrowly elliptic, lanceolate or oblanceolate; lateral veins dense, forming an angle of 40–60° with the midrib. Cupule sessile, appendages straight or slightly recurved. Acorn conical…..………..........………….................………….**32. L. kochummenii**

16. Petiole less than 5 mm long. Cupule covered with flexible spine-like appendages. Leaves sparsely to densely tomentose with stellate hairs on both surfaces; base usually asymmetrical…………………………………...…………….…..………**14. L. coopertus**
    Petiole 5–25 mm long. Cupule smooth and often with longitudinal streaks, lamellate or irregularly tuberculate and ridged. Leaves sparsely to densely appressed tomentose below; base symmetrical..……………………….............…………………………...17

17. Leaves densely appressed tomentose below; intercoastal venation lax. Cupule irregularly tuberculate and ridged……….................……….......................…..**12. L. confragosus**
    Leaves sparsely appressed tomentose below; intercoastal venation dense. Cupule lamellate or smooth and often with longitudinal streaks……….................……………...18

18. Leaf margin undulate; lateral veins 12 pairs or more, dense. Acorn glabrous except small part at the apex………..……………………..........…………**5. L. blumeanus**
    Leaf margin not undulate, lateral veins 12 pairs or less, lax. Acorn densely simple-hairy or velvety……..……………………..…………..…………………..…………19

19. Cupule smooth and often with longitudinal streaks. Acorn ovoid, scar deeply concave, *c*. 2 cm diameter. Petiole 15–25 mm long. Leaf base rounded…..……..…..**37. L. mariae**
    Cupule lamellate. Acorn depressesed ovoid to subglobose, scar shallowly concave, 1–1.5 cm diameter. Petiole 5–15 mm long. Leaf base mostly acute.....**21. L. encleisacarpus**

20. Leaves densely hairy on both surfaces or at least below……….………………………21
    Leaves glabrous on both surfaces, or glabrous or subglabrous above and sparsely tomentose below, or sparsely tomentose on both surfaces, or covered with reddish brown papillae….…………………………………………………........……………29

21. Intercostal venation scalariform………..……………………...………………….....22
    Intercostal venation subscalariform, irregular or reticulate…………………..………24

22. Acorn densely tomentose. Cupule cup-shaped, 2.5–3.5 cm diameter, enclosing up to half of the acorn……………………………….……………......…………..**60. L. urceolaris**
    Acorn glabrous except for small part at the apex. Cupule saucer-shaped, 1.4–2.5 cm diameter, enclosing less than half of the acorn……………..……………………….....23

23. Leaves broadly lanceolate or obovate; petiole usually less than 5 mm long. Cupule muricate……………………………………………….....……………….**28. L. hystrix**
    Leaves elliptic to oblong; petiole 5–12 mm long. Cupule scaly…..…..…**57. L. sundaicus**

24. Lateral veins clearly joining near the leaf margin………………………..…………...25
    Lateral veins faintly joining or disappearing near the leaf margin…....………...…….27

25. Cupule in clusters of 2–3 and arranged closely together along the rachis…….…………………………………………………………………………………......…..**61. L. wallichianus**
Cupule solitary and distantly spaced along the rachis…………………………………26

26. Acorn densely tomentose. Leaves elliptic or obovate; intercostal venation dense, obscure above……………….........…………………………………..........…...**13. L. conocarpus**
Acorn glabrous. Leaves oblanceolate, broadly elliptic to oblong; intercostal venation lax, prominent below and impressed above…………….……...….......**41. L. nieuwenhuisii**

27. Cupule sessile. Acorn glabrous except for the apex. Leaves less than 10 cm long and 5 cm wide; apex acute or acuminate with an acumen 5–10 mm long....**27. L. havilandii**
Cupule stalked. Acorn densely tomentose or sparsely simple-hairy. Leaves more than 10 cm long and 5 cm wide; apex caudate or acuminate with an acumen 10–25 mm long……..……………………......................……………………….....……………28

28. Leaves thick-coriaceous, rigid, margin strongly revolute……..…….**17. L. dasystachyus**
Leaves thin-coriaceous, not rigid, margin slightly revolute.……...……**9. L. caudatifolius**

29. Intercostal venation obscure on both surfaces or thinly prominent below….....………..30
Intercostal venation obscure above and prominent below, or prominent on both surfaces ……………………………………………………………………………......………43

30. Leaf apex rounded, obtuse or emarginate………………………………….....……...…31
Leaf apex acute, acuminate, or caudate..……………………..…………...……..…..33

31. Leaves covered with reddish brown papillae on both surfaces, denser below…….……………………………………………………………………....………..**44. L. papillifer**
Leaves glabrous on both surfaces or sparsely to densely tomentose with a few simple and/or stellate hairs but without reddish brown papillae……..…………………………32

32. Leaves bullate, ovate, (3–)4.5–7 × 2–4 cm. Cupule 0.5–1 × 1.5–1.8 cm, lamellate…….……………………………………………………………………..………..**7. L. bullatus**
Leaves not bullate, obovate to elliptic, 10–14(–21.5) × 3–5(–7) cm. Cupule 1.5–2.5 × 3.7–5 cm, scaly…………………………………………………….…………**50. L. revolutus**

33. Leaves narrower, with a length:width ratio of 4–4.5:1…………..….…**39. L. melataiensis**
Leaves broader, with a length:width ratio of 1–3:1……………………………………34

34. Cupule scaly or armed with prickles or spine-like appendages………………………..35
Cupule lamellate……………………………………………....…...……………..…36

35. Leaves thin-coriaceous. Cupule armed with short, slender prickles or spine-like appendages. Acorn sparsely tomentose, scar 2.3–2.6 cm diameter…..**19. L. echinulatus**
Leaves thick-coriaceous, rigid. Cupule covered with distinct and rather broad scale-like appendages. Acorn glabrous and shining, scar 1.5–1.7 cm diameter…..**40. L. muluensis**

36. Leaves thick-coriaceous and rigid……………………………………………………...37
Leaves usually thin-coriaceous or rarely coriaceous but not rigid……………………..38

37. Leaf apex acute; lateral veins lax……………………………………..………....**51. L. rigidus**
Leaf apex acuminate, acumen 10–20 mm long; lateral veins dense......**26. L. hatusimae**

38. Mature cupule 1.3–1.7 cm deep………………………………...…………....**49. L. rassa**
Mature cupule 0.3–1 cm deep……..…………………………....……………….…39

39. Cupule cup-shaped, 0.6–1 cm deep. Lateral veins disappearing near the leaf margin…………………………………………………………...………**42. L. nodosus**
Cupule saucer-shaped, 0.3–0.5(–0.7) cm deep. Lateral veins faintly joining or rarely disappearing near the leaf margin…………………………...…………………..……....40

40. Cupule sessile…....……………………………………...……………...…………...41
Cupule stalked…………………………………………...…………….………...……42

41. Leaves narrowly elliptic or ovate, (5.5–)6–8.5(–10.5) × 2–4 cm, base obtuse; midrib flat above, strongly raised below; petiole 5–9 mm long. Cupule 0.3–0.5 × 0.8–1.2 cm. Acorn ovoid to conical; scar concave, 0.3–0.7 cm diameter……........**48. L. pusillus**
Leaves broadly elliptic, (9–)12–14(–17) × (4–)5–6(–7) cm, base cuneate to acute, midrib raised on both surfaces; petiole (8–)12–15 mm long. Cupule 0.5–0.7 × 1.5–2 cm. Acorn depressed ovoid to subglobose; scar deeply concave, *c.* 1 cm diameter…… ……………………………………………………………...………**2. L. bancanus**

42. Leaf base rounded; lateral veins forming an angle of 30–40° with the midrib. Petiole 5–7 mm long…...…………………………………………..……………**1. L. andersonii**
Leaf base attenuate to acute; lateral veins forming an angle of 45–60° with the midrib. Petiole 10–15 mm long……….…………………..……………………..………**4. L. bennettii**

43. Cupule variously scaly……………………………………………...…………………..44
Cupule lamellate……………………………………..……..……….……………..……49

44. Lateral veins disappearing near the leaf margin…………………..…..**33. L. lampadarius**
Lateral veins clearly to faintly joining near the leaf margin…..…………………………45

45. Leaves sparsely tomentose with stellate and simple hairs on both surfaces. Acorn conical……..…………………………...…………………………………**34. L. leptogyne**
Leaves glabrous on both surfaces. Acorn ovoid, cylindrical, depressed ovoid or subglobose……………………………………………….....…..…………………..46

46. Leaf base cordate to auriculate…………………………….……..………..**29. L. jacobsii**
Leaf base acute, attenuate, cuneate, obtuse or rounded………………..………………..47

47. Acorn glabrous. Leaf base acute or cuneate………………………………**20. L. elegans**
Acorn densely or sparsely brownish simple-hairy or velvety. Leaf base rounded, attenuate or obtuse…...………………………........…....…………………………..………48

48. Acorn ovoid, 1.5–2 cm long, densely covered with reddish brown simple, long and stellate hairs…………………....………….........………………………..**23. L. ferrugineus**
Acorn cylindrical, 2.5–3.7 cm long, sparsely greyish simple-hairy especially at the base and apex………...…………………………………………..**46. L. pseudokunstleri**

49. Acorn glabrous or hairy on the upper part only……………………………………………..50
Acorn variously hairy all over…………………………...……………………………………56

50. Leaves thick-coriaceous; midrib strongly raised on both surfaces; intercostal venation lax……..……………………………………………………………………......………..……51
Leaves coriaceous to thin-coriaceous; midrib faintly raised on both surfaces; intercostal venation dense…………………………………………...………………..…………..52

51. Leaf base rounded to acute; lateral veins disappearing near the leaf margin, lax; intercostal venation reticulate, obscure above. Cupule 2–3 × 4–5 cm, lamellae strongly raised. Acorn 3–4 × 3–5 cm, scar deeply concave, 2–2.5 cm diameter…**56. L. stonei**
Leaf base cuneate; lateral veins faintly to clearly joining near the leaf margin, dense; intercostal venation scalariform, prominent on both surfaces. Cupule 0.5–1 × 1.5–2.5 cm, lamellae slightly distinct. Acorn 1–2 × 1.5–2 cm, scar shallowly concave or flat, 1–1.4 cm diameter…………………………...……….……..**8. L. cantleyanus**

52. Leaves oblanceolate; base cuneate, decurrent……………………….……………………53
Leaves elliptic, ovate or oblong; base rounded, obtuse to cordate……….………………54

53. Leaves with a length:width ratio of 2:1, coriaceous, sometimes rigid, glabrous on both surfaces; intercostal venation distinct on both surfaces. Cupule cup- to saucer-shaped……………………………………………………...…………...**35. L. lucidus**
Leaves with a length:width ratio of 2.5–3:1, thin-coriaceous, not rigid, glabrous above, sparsely appressed tomentose below; intercostal venation obscure above, prominent below. Cupule saucer-shaped…………..…………………......……**43. L. oblancifolius**

54. Leaf margin often undulate; lateral veins forming an angle of 30–45(–60º) with the midrib. Cupule lamellae with dentate edge.……………..……...……….**24. L. gracilis**
Leaf margin not undulate; lateral veins forming an angle of 45–60º with the midrib. Cupule lamellae with minutely denticulate or entire edge…………………..……...55

55. Lateral veins 7–11 pairs. Cupule subsessile, saucer-shaped, 1.2–1.7 cm diameter, edge of lamellae minutely denticulate………..……………………..………...**11. L. confertus**
Lateral veins 12–16 pairs. Cupule with stalk 5–10 mm long, cup-shaped, 2–2.5 cm diameter, lamellae entire…………………………………......……….**22. L. ewyckii**

56. Leaves 26–46 cm long…………………………….…………...……..**54. L. sandakanensis**
Leaves 7–27 cm long…………………………….…...….……………….……………57

57. Intercostal venation subscalariform or reticulate…………...……………………………58
Intercostal venation scalariform………………………...…………………...……...59

58. Leaves thick-coriaceous; lateral veins disappearing near the leaf margin. Acorn densely greyish hairy……………….…………...…………………….**10. L. clementianus**
Leaves thin-coriaceous; lateral veins faintly joining near the leaf margin. Acorn sparsely hairy…..……..………………………………..............……….**16. L. daphnoideus**

59. Scar of acorn flat or shallowly concave………..………………..…………..**36. L. luteus**
Scar of acorn deeply concave……………….……………........……..……..60

60. Cupule sessile. Acorn densely silvery grey tomentose with simple hairs; scar 1.5–2 cm diameter. Leaves (11–)13–16(–20) × (4–)5–7(–8.5) cm; base cuneate, decurrent; midrib flat above, raised below…..…………..……………..…..…………**38. L. meijeri**
Cupule with stalk 5–10 mm long. Acorn densely sericeous; scar 2–3 cm diameter. Leaves (9–)12–13.5 × (3–)4–6 cm; base acute; midrib raised on both surfaces..……… ………………………………..……..**55. L. sericobalanus**

1. **Lithocarpus andersonii** Soepadmo

(J.A.R. Anderson, former Forest Officer in Sarawak and Brunei)

Reinwardtia 8 (1970) 215, *l.c.* (1972) 365; Anderson *l.c.* 199; Whitmore, Tantra & Sutisna, *l.c.* 154; PROSEA 5, 2 (1995) 288; Coode *et al.* (eds.) *l.c.* 124; Argent *et al.* (eds.) *l.c.* 243. **Type:** *Anderson 5102*, Borneo, Sarawak, Mukah (holotype L; isotypes K, SAR).

Tree up to 30 m tall, 60 cm diameter; stilt-roots occasionally present, up to 1.8 m tall. **Bark** smooth, brownish; inner bark fibrous, brownish. **Sapwood** yellowish. **Twigs** glabrescent, sparsely to densely lenticellate. **Stipules** ovate, acute, 3–4 × 1–2 mm. **Leaves** *thin-coriaceous to coriaceous*, *not rigid*, *glabrous above*, *sparsely appressed greyish tomentose below*; broadly elliptic, *(6–)7–10(–12) × 2–4(–5) cm*; *base rounded*, rarely acute, *margin slightly revolute*, *apex acuminate*, *acumen 10–20 mm long*; midrib raised on both surfaces, stronger and glabrescent below; *lateral veins* thin, (6–)9–11 pairs, lax, flat but clearly visible on both surfaces, *faintly joining near the leaf margin*, *forming an angle of 30–40° with the midrib*; *intercostal venation reticulate*, lax, *obscure on both surfaces*; *petiole 5–7 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 5–10 cm long; bracts and bracteoles ovate, 0.3–0.6 × 0.2–0.5 mm. **Male flowers** in clusters of 2–3 along the rachis; perianth lobes acute, *c.* 1.2 × 0.7 mm; stamen filaments 2–3 mm long; pistillode subglobose, 1–1.2 mm diameter. **Androgynous inflorescences** 7–10 cm long; bracts and bracteoles ovate, *c.* 0.4 × 0.2 mm. **Female flowers** solitary along the rachis; perianth lobes obtuse, 0.5–0.6 mm across; staminodes 12; styles conical, straight, *c.* 1 mm long. **Cupules** solitary along the rachis, *saucer-shaped*, *0.5–0.7 × 1.5–1.7(–2) cm*, densely appressed tomentose, *lamellate*; *stalk 3–4 mm long*; wall woody, thin, enclosing less than half of the acorn; lamellae distinct, edge denticulate, set in 5–6 regular lines. **Acorns** ovoid to conical, 1.2–2.3 × 1.6–1.8 cm, *most part exserted*, glabrous, dark purplish brown; base flat, apex acute; scar deeply concave, 0.8–1.3 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Vernacular names. Sarawak—*empenit batu*, *empili pipit* (Iban), *empenit padang*, *empenit jangkar* (Malay), *kayu kikai*, *penyibong* (Melanau Oya), *keraki boras* (Bidayuh), *tekaled* (Melanau).

Distribution. Endemic to Borneo. So far not known in Sabah. In Sarawak, uncommon but distributed throughout Sibu, Kapit, Sarikei, Sri Aman, and Kuching districts. Also in Brunei.

Ecology. In primary and secondary peatswamp and *kerangas* forests, at low altitude.

2. **Lithocarpus bancanus** (Scheff.) Rehder
(of Bangka, Sumatra)

J. Arn. Arb. 10 (1929) 132; Soepadmo *l.c.* (1970) 218, *l.c.* (1972) 360; Cockburn *l.c.* (1972) 213; Anderson *l.c.* 199; Whitmore, Tantra & Sutisna *l.c.* 154; Turner *l.c.* 235; PROSEA *l.c.* 288; Coode *et al.* (eds.) *l.c.* 124; Argent *et al*. (eds.) *l.c.* 243. **Basionym:** *Quercus bancana* Scheff., Nat. Tijd. Ned. Ind. 31 (1870) 361. **Type:** *Teijsmann 224*, Sumatra, Bangka, Batu Balai (holotype BO; isotype U). **Synonyms:** *Synaedrys bancana* (Scheff.) Koidzumi, Bot. Mag. Tokyo 30 (1916) 190; *Pasania bancana* (Scheff.) Markgr., Bot. Jahrb. 59 (1924) 79; *Q. rajah* Hance, J. Bot. 16 (1878) 198; *S. rajah* (Hance) Koidzumi *l.c.* (1916) 192; *P. rajah* (Hance) S. Moore, J. Bot. 63 (1925) 115; *L. rajah* (Hance) A. Camus, Riviera Scientific 18 (1932) 41; *Q. scyphigera* Hance var. *riedelii* King, Ann. Roy. Bot. Gard. Calc. 2 (1889) 39; *L. scyphigera* (Hance) A. Camus var. *riedelii* (King) A. Camus, Chênes 3 (1954) 962.

Tree up to 25 m tall, 50 cm diameter. **Bark** smooth or scaly, yellowish to greyish brown; inner bark fibrous, pinkish. **Sapwood** yellowish. **Twigs** sparsely appressed tomentose, late-glabrescent, smooth or sparsely lenticellate. **Stipules** deltoid, 0.5–1 × 0.5 mm. **Leaves** *thin-coriaceous*, *rarely coriaceous but not rigid*, *glabrous above*, *sparsely yellowish to brownish appressed tomentose with simple hairs and sometimes mixed with a few stellate hairs below*; *broadly elliptic*, *(9–)12–14(–17) × (4–)5–6(–7) cm*, *base cuneate to acute*, *margin slightly revolute*, *apex acuminate*, *acumen 5–15 mm long*; *midrib* thin, *raised on both surfaces*, stronger and sparsely to densely appressed tomentose below; *lateral veins* thin, (9–)10–12(–14) pairs, lax, flat on both surfaces or silghtly raised below, *faintly joining near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation subscalariform to subreticulate*, dense, *obscure on both surfaces*; *petiole (8–)12–15 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 5–20 cm long; bracts and bracteoles ovate, 0.5–1 × 0.5 mm. **Male flowers** solitary along the rachis; perianth lobes acute, 4–6 × 2–3 mm; stamen filaments 2.5–3.5 mm long; pistillode globose, *c.* 1 mm diameter. **Androgynous** or **mixed inflorescences** 10–16 cm long; bracts and bracteoles ovate, 0.5–1 × 0.5 mm. **Female flowers** solitary along the rachis; perianth lobes acute, 4–5 mm across; staminodes 12; styles conical, recurved, 1–1.5 mm long. **Cupules** solitary along the rachis, *sessile*, *saucer-shaped*, *0.5–0.7 × 1.5–2 cm*, densely appressed tomentose, *lamellate*; wall woody, thin, enclosing less than half of the acorn; lamellae distinct, edge denticulate, set in 5–6 regular lines. **Acorns** *depressed ovoid to subglobose*, 1.5–2 cm across, *most part exserted*, glabrous, brownish; base rounded, apex rounded and abruptly acute, *scar deeply concave*, *c. 1 cm diameter*; *wall woody*, *thin*, *most part free from the cupule.*

Distribution. Sumatra, Peninsular Malaysia and Borneo. Uncommon. In Sabah, only recorded from Mt. Silam in Lahad Datu district. In Sarawak, only known from Kuching district. Also in Brunei.

Ecology. In hill mixed dipterocarp forest on clay and sandstone-derived soils, up to 900 m altitude. In Sarawak also recorded in peatswamp forest.

3. **Lithocarpus beccarianus** (Benth.) A. Camus
(Odoardo Beccari, 1834–1920, Italian explorer and botanist)

Riviera Scientific 18 (1932) 39; Soepadmo *l.c.* (1970) 220, *l.c.* (1972) 329; Cockburn *l.c.* (1976) 100;

Whitmore, Tantra & Sutisna *l.c.* 154; PROSEA *l.c.* 289; Coode *et al.* (eds.) *l.c.* 124; Argent *et al.* (eds.) *l.c.* 247. **Basionym:** *Quercus beccariana* Benth. *in* Hooker *f.*, Icon. Pl. 14 (1880) 10. **Type:** *Beccari PB 3310*, Borneo, Sarawak, Marop, near Batang Lupar (holotype FI; isotypes A, BM, K). **Synonyms:** *Pasania beccariana* (Benth.) Prantl *in* Engler & Prantl, Nat. Pflz. Fam. 3, (1894) 55; *Synaedrys beccariana* (Benth.) Koidzumi *l. c.* (1916) 188.

Tree up to 30 m tall, 60 cm diameter. **Bark** scaly, brown; inner bark fibrous, brown to yellowish brown. **Sapwood** yellowish brown. **Twigs** densely tomentose, late-subglabrescent, smooth or finely fissured. **Stipules** linear, 1.5–2 × 0.5–0.7 mm, caducous. **Leaves** *coriaceous*, *glabrous above*, *densely tomentose with stellate hairs below*; narrowly elliptic or ovate, (6–)8–12 × 3–5(–6) cm, base acute to cuneate, margin revolute, apex abruptly acute to acuminate, acumen 10–15 mm long; midrib impressed or flat above, raised below; *lateral veins* thin, 6–8(–12) pairs, lax, flat above, raised below, *faintly joining or disappearing near the leaf margin*, forming an angle of 30–45° with the midrib; *intercostal venation scalariform*, *lax*, slightly prominent on both surfaces or obscure above; *petiole 5–18 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 5–8 cm long; bracts and bracteoles ovate, *c.* 0.5 mm across. **Male flowers** in clusters of 2–3 along the rachis; perianth lobes acute, *c.* 1 × 0.5 mm; stamen filaments *c.* 3 mm long; pistillode subglobose, *c.* 2 mm diameter. **Androgynous inflorescences** 5–10 cm long; bracts ovate, *c.* 1.5 × 0.5 mm; bracteoles ovate, *c.* 0.5 × 0.3 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 0.5 mm across; staminodes 12; styles conical, straight, *c.* 1 mm long. **Cupules** *ellipsoid*, solitary along the rachis, *sessile*, *6–7(–12.5) × 2.5–3.5(–6.5) cm*, tomentose, *lamellate*; *wall* woody, thick, *smooth*, densely hairy, *enclosing the acorn completely*, *without apical opening*; *lamellae distinct but not strongly raised*, *edge entire or minutely denticulate*, set in 6–8 lines. **Acorns** ellipsoid, 5–6 × 4–5 cm, tomentose, brown; base rounded, apex rounded or somewhat flat; *wall woody*, *thick*, *most part adnate to the cupule.*

Distribution. Endemic to Borneo. In Sabah recorded for Beaufort, Tambunan and Tawau districts. In Sarawak known from Mt. Buri in Samarahan district, Mt. Hose in Kapit district and from the type locality. Also in Brunei and Kalimantan.

Ecology. In primary mixed dipterocarp forest, up to 300 m altitude.

4. **Lithocarpus bennettii** (Miq.) Rehder

(J.J. Bennett, 1801–1876, English botanist)

J. Arn. Arb. 1 (1919) 123; Soepadmo *l.c.* (1970) 220, *l.c.* (1972) 356; Cockburn *l.c.* (1972) 215, *l.c.* (1976) 102; Anderson *l.c* 199; Corner *l.c.* 339; Whitmore, Tantra & Sutisna *l.c.* 155; Turner *l.c.* 235; PROSEA *l.c.* 289; Coode *et al.* (eds.) *l.c.* 124; Argent *et al.* (eds.) *l.c.* 247. **Basionym:** *Quercus bennettii* Miq., Fl. Ind. Bat. 1, 1 (1856) 857. **Type:** *Horsfield HB 3402*, Sumatra, Bangka, Djebus (holotype U; isotypes CGE, K). **Synonyms:** *Cyclobalanus bennettii* (Miq.) Oerst., Köng. Danske Vid. Selsk. Skrift. 5, 9 (1871) 375; *Pasania bennettii* (Miq.) Gamble, J. Roy. As. Soc. Beng. 75, 2 (1915) 433; *Synaedrys bennettii* (Miq.) Koidzumi *l.c.* 190.

Tree up to 35 m tall, 80 cm diameter; buttresses up to 3 m high, stilt-root occasionally present. **Bark** smooth or fissured, greyish brown; inner bark fibrous, yellowish brown. **Sapwood** yellowish. **Twigs** glabrescent, sparsely lenticellate or smooth. **Stipules** linear, 2.5–3.5 × 1 mm. **Leaves** *thin-coriaceous to coriaceous*, *not rigid*, *glabrous above*, *sparsely yellowish appressed tomentose below*; *broadly elliptic*, *(7.5–)9.5–12(–15) × (3–)3.5–5.5(–7) cm*, *base attenuate to acute*, *margin slightly revolute*, *apex acuminate*, *acumen 5–15 mm long*; midrib strongly raised above, slightly raised or flat and glabrescent below; *lateral veins* thin, (8–)9–12 pairs, lax, slightly raised or flat on both surfaces, *faintly joining or disappearing near the leaf margin*, *forming an angle of 45–60° with the midrib*; *intercostal venation subscalariform* or *reticulate*, dense, *obscure above and thinly prominent below or obscure on both surfaces*; *petiole 10–12(–15) mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 7–20 cm long; bracts and bracteoles ovate, 0.5–1 × 0.3–0.6 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1 × 0.8 mm; stamen filaments *c.* 2.5 mm long; pistillode subglobose, *c.* 1.3 mm diameter. **Androgynous inflorescences** 10–20 cm long; bracts ovate, *c.* 0.9 × 0.6 mm; bracteoles subrounded, 0.2–0.3 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1 × 0.5 mm; staminodes 12; styles conical, straight, *c.* 1 mm long. **Cupules** solitary along the rachis, *with stalk c. 5 mm long*, *saucer-shaped*, *0.3–0.5 × 1–2 cm*, densely appressed tomentose with simple hairs, *lamellate*; wall bony, thin, enclosing less than half of the acorn; lamellae slightly distinct, edge minutely denticulate, set in 5–7 regular lines. **Acorns** ovoid to conical, 1–1.7 × 1.3–2 cm, *most part exserted*, glabrous except for the sparsely simple-hairy apex, dark purplish brown; base flat, apex acute; scar deeply concave, *c.* 1 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Vernacular name. Sarawak—*empili pipit* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Singapore and Borneo. Uncommon but widely distributed throughout Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary and secondary mixed dipterocarp and *kerangas* forests, on a wide range of soils, at 200–1200 m altitude. In Sarawak also known in limestone hills.

5. **Lithocarpus blumeanus** (Korth.) Rehder

(C.L. Blume, 1796–1862, German medical doctor; 1822–1826 Assistant Director of the Bogor Botanic Garden, 1829 Director of the Rijksherbarium, Leiden)

J. Arn. Arb. 10 (1929) 132; Soepadmo *l.c.* (1970) 221, *l.c.* (1972) 339; Cockburn *l.c.* (1976) 105; Anderson *l.c.* 199; Whitmore, Tantra & Sutisna *l.c.* 155; Coode *et al.* (eds.) *l.c.* 125. **Basionym:** *Quercus blumeana* Korth., Kruidk. (1844) 208. *t.* 44. **Type:** *Korthals s.n.* (= *RHL Sheet No 901309475*), Borneo, SE Kalimantan, Dusun R. (Barito) (holotype L; isotype A). **Synonyms:** *Cyclobalanus blumeana* (Korth.) Oerst., Vid. Medd. Naturh. For. Kjöbn. 8 (1867); *Synaedrys blumeanus* (Korth.) Koidzumi *l.c.* 186; *Castanopsis blumeanus* (Korth.) Rehder *l.c.* (1919) 122.

Tree up to 15 m tall, 25 cm diameter. **Bark** scaly, greyish brown; inner bark fibrous, brown. **Sapwood** yellowish. **Twigs** subglabrous, sparsely lenticellate. **Stipules** triangular, *c.* 2 × 1 mm. **Leaves** thin-coriaceous, glabrescent above, *sparsely appressed brownish tomentose below*; broadly ovate or broadly elliptic or sometimes elliptic-oblong, (8–)12–16(–23) × (3.5–)5–8.5(–11) cm, *base* rounded, subcordate or broadly acute, *symmetrical*, *margin undulate*, revolute, apex acuminate, acumen 10–15 mm long; midrib raised on both surfaces, stronger and sparsely tomentose below; *lateral veins* thin, *12–15(–17) pairs*, *dense*, flat above, raised below, *faintly joining near the leaf margin*, forming an angle of 30–45° with the midrib; *intercostal venation* reticulate, *dense*, obscure above, prominent below; *petiole 10–13 mm long*. **Inflorescences** male, female or androgynous. **Male inflorescences** 15–20 cm long; bracts triangular, *c.* 0.9 × 0.6 mm; bracteoles broadly ovate, acute, *c.* 0.3 × 0.2 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes acute, *c.* 0.7 × 0.5 mm; stamen filaments *c.* 3 mm long; pistillode globose, *c.* 1 mm diameter. **Female** or **androgynous inflorescences** 10–15 cm long; bracts ovate, *c.* 0.4 × 0.2 mm; bracteoles subrounded, 0.2–0.3 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 0.8 × 0.5 mm; staminodes 12; styles cylindrical, slightly recurved, *c.* 1.2 mm long. **Cupules** solitary along the rachis, with stalk 5–10 mm long, 1–1.5 × 2.5–3 cm, tomentose, *lamellate*; wall bony, thin, *enclosing the acorn almost completely or for its most part*; lamellae slightly distinct, edge denticulate, set in 5–6 regular lines. **Acorns** depressed ovoid, 1.5–2 × 2.5–3 cm, *glabrous except for a small part at the apex which is densely simple and stellate hairy*; base rounded, apex acute; scar deeply concave or flat, *c.* 1.4 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Distribution. Peninsular Malaysia and Borneo. In Sabah, recorded in all districts. In Sarawak, known in Kuching, Sri Aman, Kapit, Miri, and Limbang districts. Also in Brunei and Kalimantan.

Ecology. In primary mixed dipterocarp forest to lower montane forest, up to 1600 m altitude, mainly on clay soils of igneous origin.

6. **Lithocarpus brochidodromus** S. Julia & Soepadmo Fig. 8.

(Latin, *brochidodromus* = loop-veined; the leaves)

Gard. Bull. Sing. 50 (1998) 125. **Type:** *Dewol & Lideh SAN 105591,* Borneo, Sabah, Pensiangan, Sapulut, Sg. Saburan (holotype SAN).

Tree up to 30 m tall, 55 cm in diameter. **Bark** flaky, greyish or brownish; inner bark reddish or greyish or greenish. **Sapwood** brownish or whitish. **Twigs** densely tomentose with appressed stellate and simple hairs, subglabrescent, smooth or sparsely large-lenticellate, sometimes scaly. **Stipules** linear or narrowly ovate, 5–15 × 2–5 mm. **Leaves** coriaceous, rigid, sparsely appressed yellowish tomentose with simple and stellate hairs or rarely glabrous above, densely appressed yellowish tomentose below; *elliptic-oblong or broadly ovate*, 14–22(–32) × 5–9(–11) cm, base rounded or acute, margin strongly revolute, apex acuminate, acumen 15–20 mm long; midrib broad, slightly raised above, strongly raised below; *lateral veins* thick, 7–12 pairs, *lax*, *strongly impressed above*, strongly raised below, *clearly and strongly joining near the leaf margin*, *forming an angle of 60–80° with the midrib*; intercostal venation scalariform, lax, prominent and impressed above, strongly prominent below; *petiole 4–12 mm long*. **Inflorescences** male and female. **Male inflorescences** 6–10 cm long; bracts linear to narrowly ovate, 1.5–3.5 × 1–2 mm; bracteoles linear, *c.* 1.7 × 0.6 mm. **Male flowers** solitary along the rachis; perianth lobes acute, 2.5–3 × 1–1.5 mm; stamen filaments *c.* 2 mm long; pistillode subglobose, 1.5–2 mm in diameter. **Female inflorescences** 14–18 cm long; bracts ovate, 2–2.5 × 1–1.7 mm; bracteoles linear to narrowly elliptic, *c.* 2 × 0.5 mm. **Female flowers** solitary along the rachis; perianth lobes obtuse, 0.4–0.7 mm across; staminodes 12; styles conical, slightly

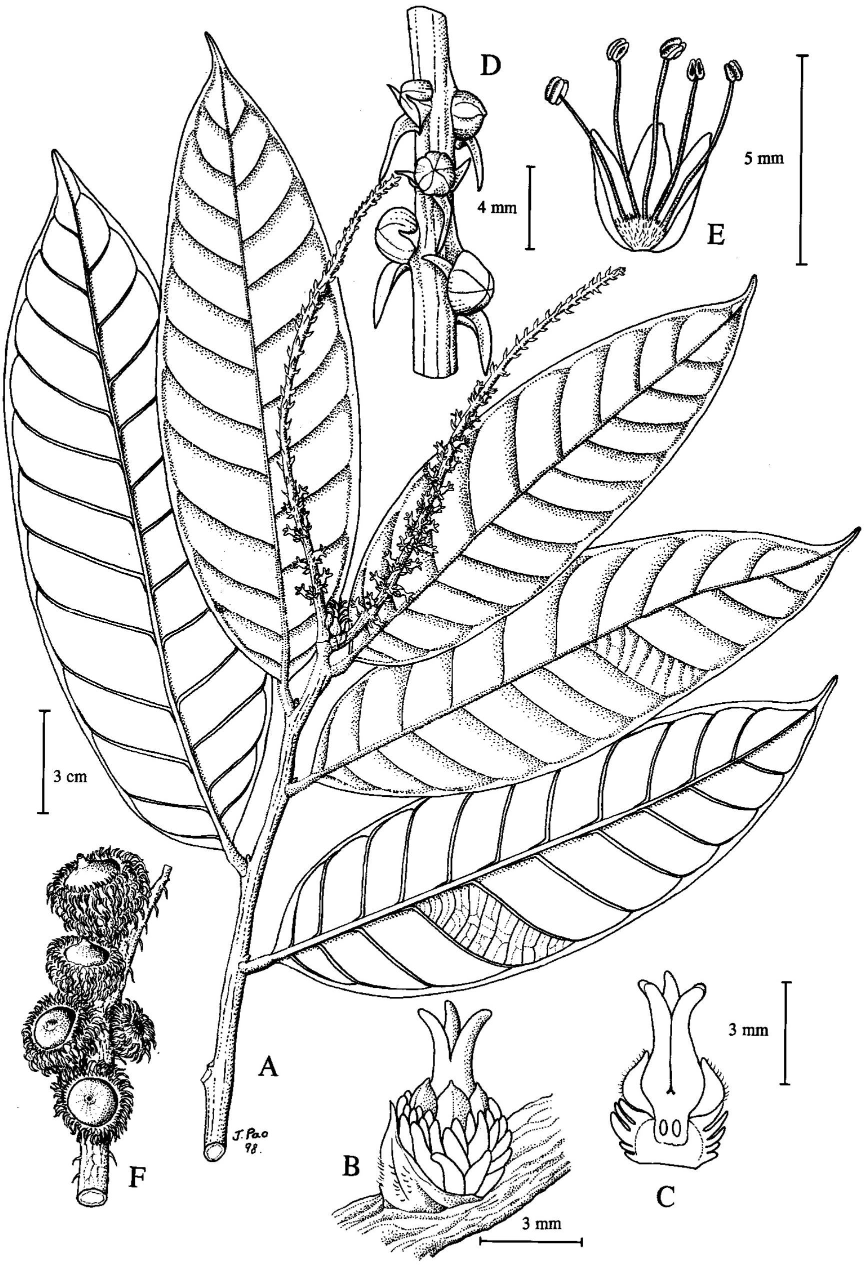

Fig. 8. *Lithocarpus brochidodromus*. A, leafy flowering (female) twig; B, female flower; C, longitidunal section of female flower; D, part of male inflorescence; E, male flower with 3 of the 6 perianth lobes removed; F, infructescence. (A–C from *SAN 103647*, D–E from *S. 24089*, F from *SAN 106929*.)

recurved, 1.5–2.5 mm long. **Cupules** solitary along the rachis, *with stalk c. 5 mm long*, 1.5–2.5 × 2–2.5 cm, densely appressed stellate-tomentose; *set with recurved hook-like appendages*; wall bony, thick, *enclosing the acorn completely or more than half of the acorn*; hook-like appendages distinct, sturdy, set irregularly. **Acorns** *ovoid to subglobose*, 1.5–2 cm across, sparsely tomentose with simple hairs, brown; base flat, apex rounded to acute; scar convex, *c.* 1 cm in diameter; *wall thin*, *most part free from the cupule*.

Vernacular names. Sabah—*tikalod* (Dusun, Ranau). Sarawak—*tekalat* (Murut).

Distribution. Endemic to Borneo. In Sabah, recorded from Sapulut in Keningau, Ulu Tungud in Beluran, and Sg. Timbulanan in Labuk Sugut districts. In Sarawak, collected from Belaga district and Lambir NP in Miri district. Not yet reported for Brunei and Kalimantan.

Ecology. In primary and secondary lowland and hill mixed dipterocarp forests, including riparian forest, up to 500 m altitude.

7. **Lithocarpus bullatus** Soepadmo

(Latin, *bullatus* = inflated or blistered; the leaf surface)

Reinwardtia 8 (1970) 223, *l.c.* (1972) 356; Cockburn *l.c.* (1976) 102. **Type:** *Clemens 32715*, Borneo, Sabah, Mt. Kinabalu (holotype BO; isotypes A, BM, K, L, NY, UC).

Tree up to 25 m tall, 40 cm diameter. **Bark** fissured or smooth or lenticellate, greyish brown; inner bark granular, reddish. **Sapwood** reddish. **Twigs** sparsely tomentose, late-glabrescent, sparsely minute-lenticellate. **Stipules** lanceolate, 1–3 × 1 mm. **Leaves** thick-coriaceous, *bullate*, rigid, *sparsely tomentose or glabrescent above*, *sparsely greyish appressed tomentose below*; *ovate*, *(3–)4.5–7 × 2–4 cm*, base acute, *margin strongly revolute*, *apex obtuse*, *rounded or rarely emarginate*; midrib slightly raised above, strongly raised and sparsely tomentose below; lateral veins thick, 7–8(–10) pairs, lax, impressed above, strongly raised below, disappearing near the leaf margin, forming an angle of *c.* 45° with the midrib; *intercostal venation scalariform*, lax, *obscure on both surfaces or slightly prominent below*; *petiole 4–7(–9) mm long*. **Inflorescences** male, female and mixed. **Male inflorescences** 6–10 cm long; bracts and bracteoles ovate, 1–1.2 × 0.7–0.8 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, 1–1.2 mm across; stamen filaments *c.* 2 mm long; pistillode subglobose, *c.* 1 mm diameter. **Female** or **mixed inflorescences** 5–10 cm long; bracts and bracteoles ovate, *c.* 1.5 × 0.9 mm. **Female flowers** in clusters of 3 or solitary along the rachis; perianth lobes acute, *c.* 1.5 × 1 mm; staminodes 12; styles conical, straight, 2–2.5 mm long. **Cupules** solitary along the rachis, rarely in clusters of 2–3, sessile, saucer-shaped, *0.5–1 × 1.5–1.8 cm*, densely tomentose, *lamellate*; wall woody, thin, enclosing less than half of the acorn; lamellae slightly distinct, edge minutely denticulate, set in 5–8 regular lines. **Acorns** ovoid to conical, 1.5–2 cm across, *most part exserted*, glabrous, dark brown, base rounded, apex abruptly acute; scar concave, *c.* 1 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Distribution. Endemic to Borneo. In Sabah common in Tambunan district (Kinabalu Park and Mt. Alab) and in Beluran district. Uncommon in Sarawak, so far only known from G. Mulu NP in Miri district. Also in Kalimantan.

Ecology. In lower and upper montane forests, at 1500–3000 m altitude, on organic and ultrabasic soils.

8. **Lithocarpus cantleyanus** (King *ex* Hook. *f.*) Rehder

(Nathaniel Cantley, 1880–1888 Superintendent of the Singapore Botanic Gardens)

J. Arn. Arb. 1 (1919) 123, *l.c.* (1929) 132; Soepadmo *l.c.* (1970) 225, *l.c.* (1972) 352; Cockburn *l.c.* (1972) 216, *l.c.* (1976) 107; Anderson *l.c.* 199; Whitmore, Tantra & Sutisna *l.c.* 155; Turner *l.c.* 235; PROSEA *l.c.* 289; Coode *et al.* (eds.) *l.c.* 125; Argent *et al.* (eds.) *l.c.* 247. **Basionym:** *Quercus cantleyana* King *ex* Hook. *f.*, Fl. Brit. Ind. 5 (1888) 613. **Lectotype** (Soepadmo, 1970)**:** *King's Collectors 5623*, Peninsular Malaysia, Perak, Chanderiang (hololectotype K; isolectotypes BM, L, P, SING). **Synonyms:** *Pasania cantleyana* (King *ex* Hook. *f.*) Gamble *l.c.* (1915) 434; *Synaedrys cantleyana* (King *ex* Hook. *f.*) Koidzumi *l.c.* 190.

Tree up to 36 m tall, 70 cm diameter. **Bark** finely fissured or scaly or lenticellate, greyish brown; inner bark granular, yellowish or reddish. **Sapwood** yellowish. **Twigs** glabrescent, sparsely lenticellate. **Stipules** narrowly ovate to linear, 3–5 × 1–2 mm. **Leaves** *thick-coriaceous*, *glabrous and shining above*, *sparsely appressed greyish tomentose below*; elliptic, (10–)11.5–16(–26.5) × (4–)5–7(–11) cm, *base cuneate*, margin strongly revolute, apex acute to acuminate, acumen 5–15 mm long; *midrib strongly raised on both surfaces*; *lateral veins* thick, (12–)14–16(–18) pairs, *dense*, strongly impressed or rarely flat above, raised below, *faintly or clearly joining near the leaf margin*, forming an angle of 30–60° with the midrib; *intercostal venation scalariform*, *lax*, *prominent on both surfaces*; *petiole 10–15 mm long*. **Inflorescences** male, female or androgynous. **Male inflorescences** 10–20 cm long; bracts and bracteoles narrowly lanceolate, *c.* 1.2 × 0.5 mm. **Male flowers** in clusters of 3–4 along the rachis; perianth lobes acute, *c.* 1.3 × 0.8 mm; stamen filaments *c.* 3 mm long; pistillode subglobose, *c.* 1.2 mm diameter. **Female** or **androgynous inflorescences** 10–15 cm long; bracts ovate, *c.* 0.5 × 0.3 mm; bracteoles narrowly ovate, *c.* 0.3 × 0.2 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 0.6 × 0.4 mm; staminodes 12; styles conical, slightly recurved, *c.* 1 mm long. **Cupules** solitary along the rachis, with stalk 5–7 mm long, cup-shaped, *0.5–1 × 1.5–2(–2.5) cm*, densely tomentose, *lamellate*; wall woody, thin, densely hairy, enclosing less than half of the acorn; *lamellae slightly distinct*, edge entire or denticulate, set in 5–8 regular lines. **Acorns** ovoid, *1–1.8(–2) × 1.5–2 cm*, *most part exserted*, *glabrous*, brown; base rounded, apex abruptly acute; *scar shallowly concave or flat*, *1–1.4 cm diameter*; *wall thin*, *most part free from the cupule.*

Vernacular names. Sabah—*tikalod* (Dusun, Bundu Tuhan). Sarawak—*keraki* (Iban).

Distribution. Peninsular Malaysia, Singapore and Borneo. In Sabah, common in all districts. In Sarawak, recorded for Miri, Limbang, Kapit, Sri Aman, and Kuching districts. Also in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp forest, mainly on clay soils, up to 900 m altitude.

9. **Lithocarpus caudatifolius** (Merr.) Rehder

(Latin, *caudatus* = ending with a tail-like appendage, *folium* = leaf; the leaf with caudate apex)

J. Arn. Arb. 1 (1919) 123; Soepadmo *l.c.* (1970) 226, *l.c.* (1972) 350; Cockburn *l.c.* (1976) 99; Anderson *l.c.* 199; Whitmore, Tantra & Sutisna *l.c.* 155; PROSEA *l.c.* 290. **Basionym:** *Quercus caudatifolius* Merr., Philip. J. Sc. Bot. 3 (1908) 324. **Type:** *Borden FB 806*, the Philippines, Luzon, Bataan Prov., Mt. Mariveles, Lamao R. (holotype BM). **Synonyms:** *Q. minahassae* Koord. *ex* Elmer, Leafl. Philip. Bot. 3 (1910) 941; *L. minahassae* (Koord. *ex* Elmer) Rehder *l.c.* (1929) 133; *Synaedrys caudatifolia* (Merr.) Koidzumi *l.c.* 190; *Q. bulusanensis* Elmer, Leafl. Philip. Bot. 10 (1939) 3736; *L. bulusanensis* (Elmer) A. Camus, Not. Syst. 13 (1948) 265.

Tree up to 30 m tall, 60 cm diameter; buttresses *c.* 0.3 m tall. **Bark** scaly or smooth or fissured, greyish brown; inner bark fibrous, yellowish or brownish. **Sapwood** yellowish. **Twigs** densely tomentose with simple erect hairs, densely lenticellate. **Stipules** narrowly ovate to linear, 3–4 × 1 mm, persistent. **Leaves** *thin-coriaceous*, *not rigid*, *sparsely to densely tomentose with simple and stellate hairs above*, *densely greyish tomentose with simple-erect and stellate hairs below*; elliptic to obovate, *(5.5–)9–13(–16) × (2.5–)3–5(–7) cm*, base acute to cuneate, rarely rounded, *margin slightly revolute*, *apex caudate or acuminate*, *acumen 10–25 mm long*, rarely acute; midrib raised on both surfaces, stronger below; *lateral veins* thin, 7–10(–11) pairs, lax, flat above, raised below, *disappearing near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation subscalariform or reticulate*, lax or dense, obscure on both surfaces or thinly prominent below; *petiole 5–10 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 13–18 cm long; bracts ovate, *c.* 1 × 0.5 mm; bracteoles narrowly ovate, *c.* 0.5 × 0.2 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1 × 0.8 mm; stamen filaments 1.5–2.5 mm long; pistillode globose, *c.* 5 mm diameter. **Androgynous** or **mixed inflorescences** 11–26 cm long; bracts ovate, *c.* 1 × 0.6 mm; bracteoles subrounded, *c.* 0.5 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 0.7 × 0.5 mm; staminodes 12; styles cylindrical, straight, *c.* 1 mm long. **Cupules** solitary along the rachis, *with stalk c. 5 mm long*, cup- to saucer-shaped, 0.3–0.7(–0.9) × 1.2–2 cm, densely tomentose with simple-erect hairs, *lamellate*; wall bony, thin, densely tomentose, enclosing less than half of the acorn; lamellae slightly distinct, edge minutely denticulate, set in 5–7 regular lines. **Acorns** ovoid to conical or rarely obovoid, 1–2.5 × 1–2 cm, *most part exserted*, *densely tomentose with simple-erect hairs*, brown; base flat, apex acute; scar concave, *c.* 1 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Distribution. Borneo and the Philippines. Very common in Sabah. In Sarawak, documented only from Kuching and Marudi districts. Also in Kalimantan.

Ecology. In primary and secondary mixed dipterocarp forest to lower montane forest, up to 1400 m altitude.

10. **Lithocarpus clementianus** (King *ex* Hook. *f.*) A. Camus

(Sir Cecil Clementi Smith, former Governor of the Straits Settlements)

Riviera Scientific 18 (1932) 40; Soepadmo *l.c.* (1970) 229, *l.c.* (1972) 365; Cockburn *l.c.* (1972) 216, *l.c.* (1976) 103; Anderson *l.c.* 199; Corner *l.c.* 339; Whitmore, Tantra & Sutisna *l.c.* 155; Turner *l.c.* 235; PROSEA *l.c.* 290. **Basionym:** *Quercus clementiana* King *ex* Hook. *f. l.c.* (1888) 614. **Lectotype** (Soepadmo, 1970)**:** *Maingay 1529*, Peninsular Malaysia, Penang (hololectotype K; isolectotypes A, L). **Synonyms:** *Pasania clementiana* (King *ex* Hook. *f.*) Gamble *l.c.* (1915) 439; *Synaedrys clementiana* (King *ex* Hook. *f.*) Koidzumi *l.c.* 191; *Q. teysmannii* (*non* Blume) Heine *in* Fedde's Rep. 54 (1951) 225.

Tree up to 36 m tall, 70 cm diameter. **Bark** deeply fissured or cracked, brownish; inner bark reddish or brownish. **Sapwood** yellowish. **Twigs** densely or sparsely appressed tomentose, finely fissured or sparsely large-lenticellate. **Stipules** ovate, *c.* 2 × 1 mm. **Leaves** *thick-coriaceous*, *subglabrous above*, *sparsely yellowish appressed tomentose with simple hairs below*; elliptic to elliptic-lanceolate, *(10–)14–19(–22) × (3–)4.5–7.5 cm*, base acute, margin strongly revolute, apex acute to acuminate, acumen 10–15 mm long; midrib broad, strongly raised on both surfaces; *lateral veins* thick, (8–)10–12(–14) pairs, lax, flat or impressed above, strongly raised below, *disappearing near the leaf margin*, forming an angle of 40–50° with the midrib; *intercostal venation subscalariform*, dense, *obscure above*, *prominent below*; *petiole 5–10(–12) mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 7–12 cm long; bracts subrounded, *c.* 1 × 0.8 mm; bracteoles rounded, *c.* 0.5 mm across. **Male flowers** in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 1.5 × 1 mm; stamen filaments *c.* 1.5 mm long; pistillode subglobose, *c.* 1 mm diameter. **Androgynous** or **mixed inflorescences** 8–10 cm long; bracts and bracteoles ovate, *c.* 0.5 × 0.3–0.4 mm. **Female flowers** in clusters of 3 or solitary along the rachis; perianth lobes acute, 0.5–0.8 × 0.5–0.6 mm; staminodes 10; styles conical, straight, *c.* 1 mm long. **Cupules** in clusters of 2–3 or solitary along the rachis, sessile, cup-shaped, 1–1.5 × 2.3–3.5 cm, densely appressed tomentose with stellate hairs, *lamellate*; wall woody, thick, enclosing up to half of the acorn; lamellae distinct, edge minutely denticulate, set in 6–10 regular lines. **Acorns** depressed subglobose, 1–2 × 2–3.5 cm, *most part exserted*, *densely covered with greyish*, *simple*, *long hairs*, purplish; base flat, apex acute; scar deeply concave, *c.* 1.5 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Peninsular Malaysia and Borneo. In Sabah, very common in Ranau district and also recorded for Keningau, Sipitang and Lahad Datu districts. In Sarawak, widely distributed throughout. Also in Kalimantan.

Ecology. In hill mixed dipterocarp forest to lower montane forest on sandy soils, up to 1800m altitude.

11. **Lithocarpus confertus** Soepadmo

(Latin, *confertus* = crowded; the inflorescences and infructescences)

Reinwardtia 8 (1970) 229, *l.c.* (1972) 356; Cockburn *l.c.* (1976) 101; Anderson *l.c.* 199; Whitmore, Tantra & Sutisna *l.c.* 155. **Type:** *Clemens 29265*, Borneo, Sabah, Mt. Kinabalu, Tenompok (holotype L).

Tree up to 30 m tall, 60 cm diameter. **Bark** densely lenticellate or scaly, greyish brown; inner bark fibrous, reddish. **Sapwood** whitish. **Twigs** densely tomentose with stellate hairs, sparsely to densely lenticellate. **Stipules** lanceolate, 2–3 × 1 mm. **Leaves** *thin-coriaceous*, *subglabrous above*, *sparsely appressed yellowish brown tomentose below*; *ovate to elliptic*, (6–)9–12(–13) × (3–)4–6 cm, *base rounded or obtuse*, *margin revolute*, *not undulate*, apex acute to acuminate, acumen 10–15 mm long; *midrib faintly raised on both surfaces*, stronger below; *lateral veins* thick, *(7–)9–10(–11) pairs*, dense, flat or impressed above, strongly raised below, disappearing or faintly joining near the leaf margin, *forming an angle of 45–60° with the midrib*; *intercostal venation scalariform*, *dense*, *obscure above*, *prominent below*; *petiole 5–10 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 10–15 cm long; bracts and bracteoles ovate, *c.* 0.5 × 0.3 mm. **Male**

flowers in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 1.2 × 1 mm; stamen filaments *c.* 3 mm long; pistillode subglobose, *c.* 1 mm diameter. **Androgynous** or **mixed inflorescences** 5–10 cm long; bracts and bracteoles narrowly ovate, 0.5–1.2 × 0.3–0.6 mm. **Female flowers** solitary along the rachis; perianth lobes acute, 0.4–0.5 × 0.3 mm; staminodes 12; styles cylindrical, straight, *c.* 1.5 mm long. **Cupules** solitary along the rachis, *subsessile*, *saucer-shaped*, *0.2–0.5 × 1.2–1.7 cm*, densely tomentose with stellate and simple hairs, *lamellate*; wall bony, thin, enclosing less than half of the acorn; *lamellae slightly distinct*, *edge minutely denticulate*, set in 6–8 concentric lines. **Acorns** depressed ovoid, 1–1.7 × 1.4–2 cm, *most part exserted*, *glabrous except for the apex which is densely tomentose with stellate hairs*, dark brown or purplish; base rounded, apex acute; scar concave, *c.* 1 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Vernacular name. Sarawak—*saled birar* (Kelabit).

Distribution. Endemic to Borneo. In Sabah, very common in Ranau, Sandakan, Tambunan, and Keningau districts. In Sarawak, uncommon, recorded for Bario, Lawas, Kapit and Sri Aman districts. Also in Kalimantan.

Ecology. In primary and secondary mixed dipterocarp, peatswamp and lower montane forests, at 900–1200 m altitude; on sandstone-derived and clay soils.

Uses. In Sabah, trunks and branches are used as bed logs in mushroom cultivation.

12. **Lithocarpus confragosus** (King *ex* Hook. *f.*) A. Camus

(Latin, *con-* = together, *fragosus* = crumpled; the external surface of cupule wall)

Riviera Scientific 18 (1932) 40; Soepadmo *l.c.* (1970) 230, *l.c.* (1972) 335; Cockburn *l.c.* (1972) 216, *l.c.* (1976) 107; Anderson *l.c.* 199; Whitmore, Tantra & Sutisna *l.c.* 155; Turner *l.c.* 235; PROSEA *l.c.* 290. **Basionym:** *Quercus confragosa* King *ex* Hook. *f. l.c.* (1888) 616. **Lectotype** (Soepadmo, 1970)**:** *King's Collectors 8123*, Peninsular Malaysia, Perak, Gopeng district (holotype K; isotypes A, L, SING). **Synonym:** *Pasania confragosa* (King *ex* Hook. *f.*) Schottky, Bot. Jahrb. 47 (1912) 662.

Tree up to 30 m tall, 65 cm diameter. **Bark** smooth or scaly, lenticellate, greyish brown; inner bark fibrous, yellowish or reddish. **Sapwood** whitish. **Twigs** tomentose, late-glabrescent, densely warty lenticellate. **Stipules** linear, 8–12 × 3 mm. **Leaves** thick-coriaceous, *glabrous above*, *densely appressed yellowish tomentose below*; elliptic-oblong or broadly elliptic, (10–)12–18(–25) × 5–7(–10) cm, *base* acute to cuneate, *symmetrical*, margin revolute, apex acute to acuminate, acumen 5–10(–15) mm long; midrib raised above, strongly raised below; *lateral veins* thick, 7–9(–11) pairs, lax, impressed or flat above, strongly raised below, *disappearing near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation* subscalariform, *lax*, obscure on both surfaces or thinly prominent below; *petiole 10–20 mm long*. **Inflorescences** male, female or androgynous. **Male inflorescences** 10–16 cm long; bracts and bracteoles linear to narrowly lanceolate, *c.* 1 × 0.3 mm. **Male flowers** in clusters of 2–3 along the rachis; perianth lobes obtuse, *c.* 1 × 0.5 mm; stamens filaments 1.5–3 mm long; pistillode subglobose, *c.* 0.5 mm diameter. **Female** or **androgynous inflorescences** 9–15 cm long; bracts and bracteoles elliptic, *c.* 1 × 0.5 mm. **Female flowers** solitary along the rachis; perianth lobes rounded, 0.5–1 mm across; staminodes 12; styles cylindrical, straight, *c.* 1 mm long. **Cupules** solitary along the rachis, with stalk 5–10 mm long, depressed ovoid to depressed globose, 2–3 × 3–5.5 cm, densely tomentose, *irregularly tuberculate and ridged*; wall woody thick, *completely enclosing the acorn except for an apical opening c. 0.5 cm diameter*; *tubercles crumpled together*, distinct, set irregularly. **Acorns** depressed ovoid to depressed globose, 1.5–2.5 × 2–4 cm, free part densely tomentose with simple hairs, brown; base flat, apex flat or depressed, umbonate at the centre; scar flat, *c.* 2 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah known by a few collections from Tambunan, Lahad Datu, Ranau, Sandakan, and Tawau districts. In Sarawak, recorded for Kuching, Miri and Sri Aman districts. Also in Kalimantan.

Ecology. In primary and secondary hill mixed dipterocarp forests, up to 1100 m altitude.

13. **Lithocarpus conocarpus** (Oudem.) Rehder

(Greek, *konos* = cone, *karpos* = fruit; the conical acorn)

J. Arn. Arb. 1 (1919) 123; Soepadmo *l.c.* (1970) 231, *l.c.* (1972) 349; Cockburn *l.c.* (1972) 217, *l.c.* (1976) 108; Anderson *l.c.* 200; Corner *l.c.* 340; Whitmore, Tantra & Sutisna *l.c.* 155; Turner *l.c.* 235; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area, East Kalimantan (1994) 140; PROSEA *l.c.* 291; Coode *et al.* (eds.) *l.c.* 125; Argent *et al.* (eds.) *l.c.* 247. **Basionym:** *Quercus conocarpa* Oudem., Versl. Med. Kon. Ak. Wet. Natuurk. 12 (1861) 206. **Type:** *Junghuhn s.n.* (1857), Java, Mt. Malabar (holotype BO; isotype L). **Synonyms:** *Cyclobalanus conocarpa* (Oudem.) Oerst. *l.c.* (1867) 81; *Pasania conocarpa* (Oudem.) Schottky *l.c.* (1913) 357; *Synaedrys conocarpa* (Oudem.) Koidzumi *l.c.* 191.

Tree up to 45 m tall, 90 cm diameter. **Bark** scaly, greyish brown; inner bark granular, reddish or brownish. **Sapwood** yellowish. **Twigs** densely tomentose with simple-erect and stellate hairs, late-subglabrescent, sparsely to densely lenticellate. **Stipules** ovate, 2–3 × 1.5 mm. **Leaves** coriaceous, *densely tomentose with stellate and simple hairs above, densely appressed yellowish tomentose with simple-erect and stellate hairs below*; *elliptic or obovate*, (6–)8–11(–14) × (2–)3–4.5(–5.5) cm, base acute, sometimes asymmetrical, margin revolute, apex acute to acuminate, acumen 10–15(–20) mm long; midrib raised on both surfaces; *lateral veins* thin, 10–12(–16) pairs, dense or lax, flat or impressed above, raised below, *clearly joining near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation subscalariform*, *dense*, *obscure above*, prominent below; *petiole 5–8 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 8–16 cm long; bracts and bracteoles linear, 0.3–1.2 × 0.1–0.4 mm. **Male flowers** solitary along the rachis; perianth lobes rounded, *c.* 1 mm across; stamen filaments *c.* 2 mm long; pistillode globose, 0.5–1 mm diameter. **Androgynous** or **mixed inflorescences** 7–12 cm long; bracts ovate, *c.* 1 × 0.5 mm; bracteoles elliptic, *c.* 0.6 × 0.4 mm. **Female flowers** solitary along the rachis; perianth lobes acute *c.* 1 × 0.5 mm; staminodes 12; styles cylindrical, straight, *c.* 1 mm long. **Cupules** *solitary and distantly spaced along the rachis*, with stalk 3–8 mm long, cup-shaped, 0.4–0.8(–1) × 1.3–2 cm, densely tomentose with simple, erect hairs, *lamellate*; wall thin, densely tomentose, enclosing up to half of the acorn; lamellae slightly distinct, edge denticulate or rarely entire, set in 5–6 regular lines. **Acorns** conical or ovoid, 1.6–2 × 1.3–1.5 cm, *most part exserted*, *densely tomentose with simple*, *erect* *hairs*, *rarely glabrescent*, dark brown; base rounded, apex acute; scar concave or flat, 0.8–1.2 cm diameter; *wall woody*, *thin*, *most part free from the cupule.*

Vernacular names. Sabah—*tikalod* (Dusun, Bundu Tuhan). Sarawak—*padeh siah*, *saled* (Kelabit), *palan* (Kenyah), *piraus* (Bidayuh).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Java, and Borneo. Very common and widely distributed throughout Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland to lower montane forests, including limestone forest, mainly on clay-rich soils, up to 1400 m altitude.

Use. The timber is locally used for house-building.

14. **Lithocarpus coopertus** (Blanco) Rehder

(Latin, *coopertus* = completely concealed; the acorn)

J. Arn. Arb. 1 (1919) 124; Soepadmo *l.c.* (1970) 231, *l.c.* (1972) 335; Cockburn *l.c.* (1972) 217, *l.c.* (1976) 105; Anderson *l.c.* 200; Whitmore, Tantra & Sutisna *l.c.* 155; Kessler & Sidiyasa *l.c.* 140; PROSEA *l.c.* 291; Turner *l.c.* 235; Coode *et al.* (eds.) *l.c.* 125; Argent *et al.* (eds.) *l.c.* 247. **Basionym:** *Quercus cooperta* Blanco, Fl. Filip. (1845) 503. **Neotype:** *Elmer 14012*, the Philippines, Mindanao, Agusan Prov., Cabadbaran (holoneotype UC; isoneotypes A, BM, L, NY). **Synonyms:** *Q. fernandezii* Vidal, Sinops. (1883) 41, *t.* 92; *Q. reflexa* King *l.c.* (1889) 78, *t.* 72; *Castanea cooperta* (Blanco) Oerst. *l.c.* (1871) 379; *Synaedrys cooperta* (Blanco) Koidzumi *l.c.* 186; *Castanopsis costata* (*non* A. DC.) F.–Vill., Nov. App. Fl. Filip. 3 (1880) 209; *S. reflexa* (King) Koidzumi *l.c.* 187; *Castanopsis reflexa* (King) Rehder *l.c.* (1919) 122; *L. reflexa* (King) A. Camus *l.c.* (1932) 41; *Q. pruinosa* (*non* Blume) Elmer, Leafl. Philip. Bot. 3 (1910) 940; *Q. boholensis* Merr., Philip. J. Sc. 29 (1926) 476; *L. boholensis* (Merr.) Rehder *l.c.* (1929) 132.

Tree up to 35 m tall, 70 cm diameter. **Bark** smooth or flaky, sometimes lenticellate, greyish brown; inner bark fibrous, reddish. **Sapwood** whitish. **Twigs** densely tomentose with stellate hairs, late-subglabrescent, sparsely minute-lenticellate. **Stipules** linear, 2–3 × 1 mm. **Leaves** thin-coriaceous, *sparsely to densely appressed tomentose with stellate hairs on both surfaces*; elliptic or ovate, (5–)9–14(–17) × (2–)4–7 cm, *base* rounded to acute, *usually asymmetrical*, margin revolute, apex acute to acuminate, acumen 10–20 mm long; midrib raised on both surfaces, stronger below; *lateral veins* thin, (8–)10–13(–16) pairs, lax, flat or impressed above, raised below, *disappearing near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation scalariform*, dense, obscure on both surfaces or thinly prominent below; *petiole up to 5 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 7–15 cm long; bracts and bracteoles narrowly ovate, triangular, *c.* 1 × 0.5 mm. **Male flowers** solitary along the rachis; perianth lobes acute, *c.* 1 × 0.5 mm; stamen filaments *c.* 2 mm long; pistillode globose, *c.* 1.5 mm diameter. **Androgynous** or **mixed inflorescences** 7–15 cm long; bracts narrowly ovate, triangular, *c.* 1 × 0.5 mm; bracteoles subrounded, *c.* 0.5 mm across. **Female flowers** solitary along the rachis; perianth lobes obtuse, 0.4–0.5 mm across; staminodes 12; styles cylindrical, straight, *c.* 1 mm long. **Cupules** solitary along the rachis, subsessile or rarely with a stalk *c.* 5 mm long, ovoid to conical, 1.5–2 × 1.5–2.5 cm, densely tomentose, *covered with irregularly set*, *long, recurved, spine-like appendages*; wall bony, thin, densely hairy, *completely enclosing the acorn.* **Acorns** ovoid to conical, 1.5–2 cm diameter, free part densely tomentose, brown; base flat, apex acute; scar deeply concave to flat, 1–1.5 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Distribution. Peninsular Malaysia, Borneo and the Philippines. Common and widespread throughout Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland to hill mixed dipterocarp forest, including *kerangas* and swamp forests, up to 900 m altitude.

Uses. In Borneo, the timber is used by local people for firewood and in house construction.

15. **Lithocarpus corneri** S. Julia & Soepadmo

(E.J.H. Corner, 1906–1996, former prominent Professor of Tropical Botany at the University of Cambridge, U.K.)

Gard. Bull. Sing. 50 (1998) 128. **Type:** *Berhaman SAN 132620*, Borneo, Sabah, Tenom district, Lumaku FR (holotype SAN; isotypes KEP, L, SAR).

Tree up to 15 m tall, 30 cm in diameter. **Bark** rough, brown. **Twigs** sparsely tomentose, glabrescent, greyish brown, sparsely lenticellate, sometimes smooth. **Stipules** linear, 3–4 × 1 mm, persistent. **Leaves** thin-coriaceous, *sparsely appressed yellowish tomentose above*, *densely appressed yellowish tomentose below*; elliptic, *(6–)8–12 × 3–4.5 cm*, base acute, margin revolute, apex acuminate, acumen 5–10 mm long; *midrib raised on both surfaces*, *stronger above*; lateral veins thin, 5–8 pairs, lax, flat above, slightly raised below, disappearing near the leaf margin, forming an angle of 45–60° with the midrib; *intercostal venation subscalariform*, *dense*, obscure on both surfaces or slightly prominent below; *petiole 5–10 mm long*. **Inflorescences** and **flowers** unknown. **Cupules** solitary along the rachis, *sessile*, *obconical*, 2.5–4.5 × 3.5–5.5 cm, base attenuate, apex flat, densely appressed tomentose, *lamellate*; wall woody, 2–3 cm thick, completely enclosing the acorn except for an apical opening 1–2 cm diameter; lamellae distinct, edge entire, set in 12–15 regular lines, denser towards the apex. **Acorns** obconical, 2–4 × 3–5 cm, free apical part densely tomentose with simple and stellate hairs, brown; *wall woody*, *thick*, *most part adnate to the cupule.*

Distribution. Endemic to Sabah, Borneo. So far only known from Lumaku FR in Tenom district and Mark Pang area in Ranau district.

Ecology. In primary and secondary forests on hillsides.

16. **Lithocarpus daphnoideus** (Blume) A. Camus

(Greek, *daphnoideus* = resembling those of *Daphne*, a genus in the Thymelaeaceae; the leaves)

Riviera Scientific 18 (1932) 40; Warburg, Kew Bull. 20 (1936) 19; Soepadmo *l.c.* (1970) 234, *l.c.* (1972) 352; Cockburn *l.c.* (1972) 218; Anderson *l.c.* 200; Whitmore, Tantra & Sutisna *l.c.* 156; Turner *l.c.* 236; Coode *et al.* (eds.) *l.c.* 125. **Basionym:** Q*uercus daphnoidea* Blume, Fl. Jav. Cupul. (1829) 28. **Type:** *van Hasselt s.n.* (= *RHL Sheet No. 901310119*), W Java, Mt. Pajung (holotype L; isotypes

CGE, K). **Synonyms:** *Cyclobalanus daphnoidea* (Blume) Oerst. *l.c.* (1867) 81; *Synaedrys daphnoidea* (Blume) Koidzumi *l.c.* 191; *Pasania daphnoidea* (Blume) S. Moore, J. Bot. 63 (1925) 114; Q*uercus nitida* Blume, Mus. Bot. Lugd.-Bat. 1 (1850) 294; *Cyclobalanus nitida* (Blume) Oerst. *l.c.* (1867) 81; *L. nitida* (Blume) A. Camus, Bull. Soc. Bot. Fr. 92 (1945) 255; *Q. poculiformis* Seemen, Bot. Jahrb. 27, Beibl. 64 (1900) 13; *S. poculiformis* (Seemen) Koidzumi *l.c.* 192; *L. poculiformis* (Seemen) A. Camus *l.c.* (1932) 41; *L. sarawakensis* E.F. Warb. *l.c.* 19.

Tree up to 24 m tall, 50 cm diameter; buttresses *c.* 1 m tall. **Bark** smooth or fissured, greyish brown; inner bark granular, reddish. **Sapwood** greyish. **Twigs** sparsely tomentose, late-glabrescent, smooth or sparsely to densely minute-lenticellate. **Stipules** linear, 3–4 × 1 mm. **Leaves** *thin-coriaceous*, *glabrous above*, *sparsely appressed yellowish tomentose below*; elliptic or broadly oblanceolate, *(10–)13–16(–18) × 4–6 cm*, base acute to cuneate or rarely rounded, margin revolute, apex acuminate, acumen 10–15 mm long; midrib raised on both surfaces; *lateral veins* thin, (9–)10–13 pairs, lax, slightly raised or flat above, raised below, *faintly joining near the leaf margin*, forming an angle of 30–45° with the midrib; *intercostal venation subscalariform*, dense, *obscure above and prominent below or prominent on both surfaces*; *petiole (7–)10–15 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 13–15 cm long; bracts and bracteoles ovate, 0.6–0.8 × 0.3–0.4 mm. **Male flowers** solitary along the rachis; perianth lobes acute, *c.* 1.2 × 0.8 mm; stamen filaments *c.* 2.5 mm long; pistillode globose, *c.* 1 mm diameter. **Androgynous inflorescences** 10–15 cm long; bracts broadly ovate, *c.* 1.4 × 1 mm; bracteoles broadly ovate, *c.* 0.8 × 0.6 mm. **Female flowers** in clusters of 3 or solitary along the rachis; perianth lobes acute, 0.6–0.8 × 0.5 mm; staminodes 10; styles conical, straight, *c.* 1 mm long. **Cupules** in clusters of 2 or solitary along the rachis, sessile, cup-shaped, 1–2 × 1.5–2.5 cm, densely tomentose, *lamellate*; wall woody, thick, enclosing less than half of the acorn; lamellae distinct, edge denticulate, set in 8–10 regular lines. **Acorns** ovoid to conical, 2–2.5 × 1.8–2.5 cm cm, *most part exserted*, *sparsely simple-hairy*, dark brownish or red-brown; base flat, apex abruptly acute; scar flat to concave, 1–1.5 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Sumatra, Peninsular Malaysia, Java, and Borneo. In Sabah, recorded for Ranau, Keningau, and Tawau districts. In Sarawak, only known from Bt. Raya in Kapit district. Also in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp forest to lower montane forest, up to 1400 m altitude.

17. **Lithocarpus dasystachyus** (Miq.) Rehder

(Greek, *dasus* = thickly hairy, *stachyus* = spike; the densely pubescent inflorescences)

J. Arn. Arb. 1 (1919) 124; Soepadmo *l.c.* (1970) 234, *l.c.* (1972) 350; Cockburn *l.c.* (1976) 102; Anderson *l.c.* 200; Whitmore, Tantra & Sutisna *l.c.* 156; Coode *et al.* (eds.) *l.c.* 125; Argent *et al.* (eds.) *l.c.* 248. **Basionym:** *Quercus dasystachya* Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 221. **Type:** *de Vries s.n.*, *(1860) (= RHL Sheet No. 901310124),* Borneo, Kalimantan, Pontianak (holotype L; isotypes BO, U). **Synonyms:** *Pasania dasystachya* (Miq.) Schottky *l.c.* (1913) 356; *Synaedrys dasystachya* (Miq.) Koidzumi *l.c.* (1916) 194; *P. winkleriana* Schottky *l.c.* 357; *Q. winkleriana* (Schottky) Merr., EB (1921) 216; *L. winkleriana* (Schottky) A. Camus *l.c.* (1931) 42.

Tree up to 20 m tall, 30 cm diameter; stilt-roots occasionally present. **Bark** smooth or flaky or fissured, greyish brown; inner bark granular, brownish. **Sapwood** yellowish. **Twigs** sparsely to densely stellate-hairy, smooth or sparsely minute-lenticellate. **Stipules** ovate, deltoid to linear, 3–4 × 1–2 mm. **Leaves** *thick-coriaceous*, *rigid*, *densely stellate-hairy or sparsely tomentose*, *or rarely glabrescent above*, *densely brownish tomentose with simple-erect and stellate hairs below*; ovate, broadly ovate, elliptic or obovate, *(9–)13–19(–23) × (4.5–)6–8(–10) cm*, base acute or rounded, *margin strongly revolute*, *apex acuminate*, *acumen 10–25 mm long*; midrib strongly raised on both surfaces; *lateral veins* thin, (8–)10–15 pairs, lax, strongly impressed or flat above, raised below, *faintly joining or disappearing near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation subscalariform*, lax, rarely dense, obscure above, thinly prominent below; *petiole 5–15 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 13.5–25 cm long; bracts and bracteoles broadly ovate, 0.2–0.3 mm across. **Male flowers** solitary along the rachis; perianth lobes acute, *c.* 0.5 × 0.3 mm; stamen filaments 2–3 mm long; pistillode subglobose, 0.7–1 mm diameter. **Androgynous** or **mixed inflorescences** 11–15 cm long; bracts and bracteoles ovate, *c.* 1 × 0.5 mm. **Female flowers** solitary along the rachis; perianth lobes broadly ovate, obtuse, *c.* 0.8 × 0.5 mm; staminodes 12; styles cylindrical, straight, *c.* 1.5 mm long. **Cupules** solitary along the rachis, *with stalk 2–5 mm long*, saucer- to cup-shaped, 0.5–0.9 × 1–1.5 cm, densely tomentose, *lamellate*; wall bony, thin, enclosing less than half of the acorn; lamellae slightly distinct, edge minutely denticulate, set in 7–8 regular lines. **Acorns** ovoid to conical, 1.2–1.5 × 1–1.7(–2) cm, *most part exserted*, *sparsely simple-erect hairy or glabrescent*, dark brown; base flat, apex abruptly acute; scar deeply concave, *c.* 1 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Vernacular names. Sarawak—*bangas* (Matu Malay), *empenit padang* (Malay).

Distribution. Peninsular Malaysia and Borneo. In Sabah, known mainly from Sandakan and Lahad Datu districts. In Sarawak, very common in Kuching, Miri, Sri Aman, and Sibu districts. Also in Brunei and Kalimantan.

Ecology. Frequent in *kerangas* and peatswamp forests, but also found in primary hill mixed dipterocarp forest on ultrabasic soils, up to 1000 m altitude.

18. **Lithocarpus echinifer** (Merr.) A. Camus Fig. 9.

(Latin, *echinus* = straight prickles or spines, *fer* = bearing; the cupule)

Bull. Soc. Bot. France 81 (1934) 818; Soepadmo *l.c.* (1970) 235, *l.c.* (1972) 333; Cockburn *l.c.* (1976) 103; Anderson *l.c.* 200; Whitmore, Tantra & Sutisna *l.c.* 156; PROSEA *l.c.* 292; Coode *et al.* (eds.) *l.c.* 125. **Basionym:** *Quercus echinifera* Merr., PEB (1929) 43. **Lectotype:** *Elmer 21627*, Borneo, Sabah, near Tawau (hololectotype A; isolectotypes BM, BR, K, L, P, U).

Tree up to 35 m tall, 80 cm diameter. **Bark** fissured or smooth, greyish brown; inner bark granular, yellowish to brownish. **Sapwood** yellowish. **Twigs** sparsely tomentose, warty lenticellate. **Stipules** linear, 5–10 × 2–5 mm. **Leaves** *thick-coriaceous*, glabrous above, densely greyish tomentose with appressed hairs below; elliptic, oblong or broadly ovate, 10–18 × (4.5–)7–10(–11) cm, *base acute to cuneate*, margin revolute, apex acute or acuminate, acumen 5–10 mm long; midrib raised on both surfaces, stronger below; *lateral*

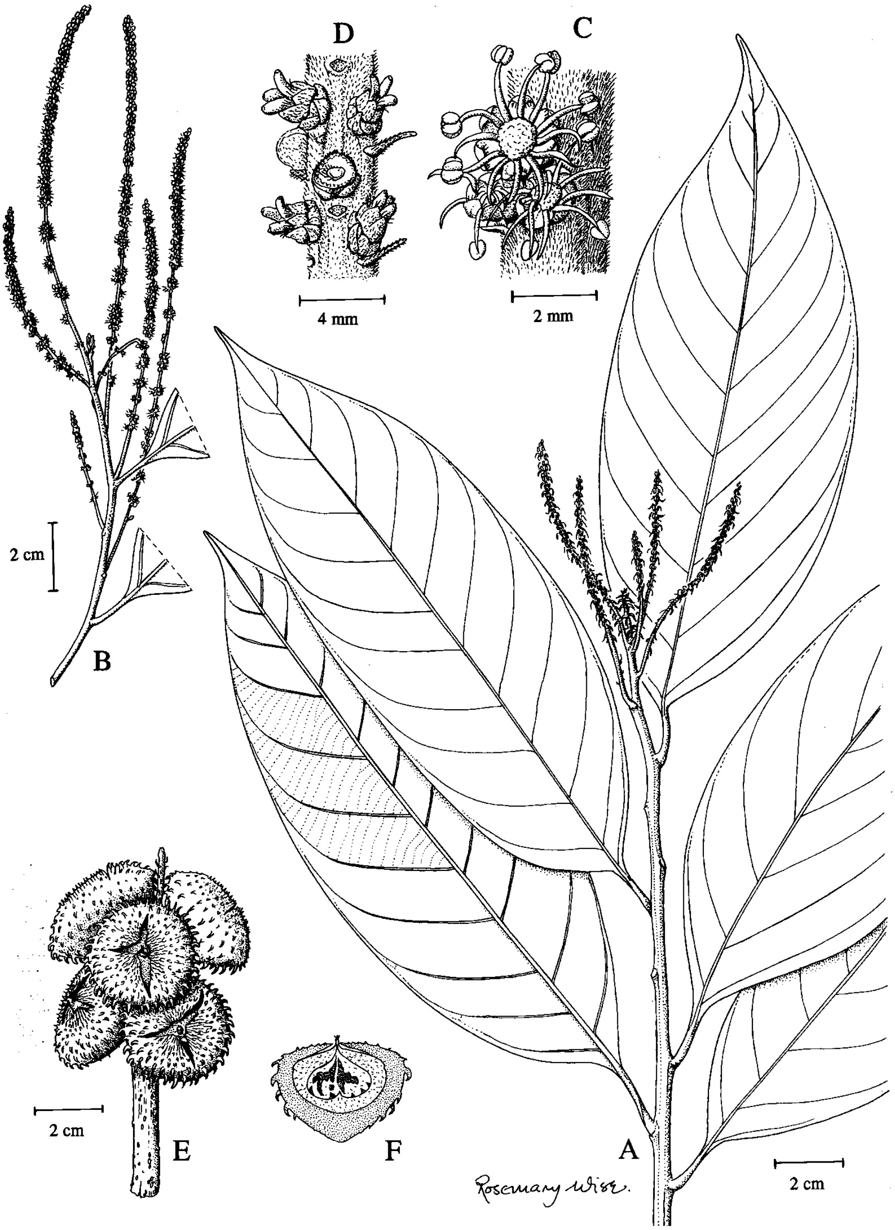

Fig. 9. *Lithocarpus echinifer*. A, leafy flowering (young) twig; B, male and androgynous inflorescences; C, clusters of 3 male flowers; D, lower part of androgynous inflorescence bearing female flowers; E, infructescence; F, longitudinal section of cupule and acorn. (A from *SAN 91707*, B–D from *BRUN 763*, E–F from *SAN 24792*.)

veins thin, 10–13 pairs, *lax*, flat above, slightly raised below, disappearing near the leaf margin, forming an angle of 45–60° with the midrib; *intercostal venation subscalariform*, dense, *obscure on both surfaces or slightly prominent below*; *petiole 15–25 mm long*. **Inflorescences** male or female. **Male inflorescences** 6–21 cm long; bracts narrowly ovate to linear, 1.5–2 × 0.5 mm; bracteoles ovate, *c.* 1 × 0.5 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1.5 × 1 mm; stamen filaments 3–5 mm long; pistillode globose, *c.* 1.5 mm diameter. **Female inflorescences** 9–18 cm long; bracts broadly ovate, *c.* 1 × 0.8 mm; bracteoles rounded, *c.* 1 × 1 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1.2 × 0.8 mm; staminodes 12; styles cylindrical, straight, *c.* 1 mm long. **Cupules** solitary along the rachis, *sessile or with stalk c. 5 mm long, obconical*, 2–3 × 2.5–4 cm, densely tomentose, *sparsely but regularly armed with prickles or spine-like*, *mostly recurved appendages*; wall bony, thin, hairy, *enclosing the acorn completely except for an apical opening c. 1 cm diameter*. **Acorns** subhemispherical, 2–3 × 3–4 cm, free part sparsely tomentose, brown; base rounded, apex flat, umbonate; *wall woody*, *thick*, *most part adnate to the cupule*.

Distribution. Endemic to Borneo. In Sabah, widely distributed in all districts. In Sarawak, recorded mainly for Miri and Kapit districts. Also in Brunei.

Ecology. In primary and secondary hill mixed dipterocarp forests, including riparian forest, up to 1000 m altitude, mainly on clay soils.

19. **Lithocarpus echinulatus** Soepadmo

(Latin, *echinulatus* = armed with short, slender prickles or spine-like appendages; the cupule)

Reinwardtia 8 (1970) 235, *l.c.* (1972) 382; Anderson *l.c.* 200; Whitmore, Tantra & Sutisna *l.c.* 156; PROSEA *l.c.* 293. **Type:** *Kostermans 13438*, Borneo, Kalimantan, Sangkulirang district, Mt. Medadam (holotype BO; isotypes BM, K, KEP, L, SING).

Tree up to 40 m tall, 80 cm diameter; buttresses *c.* 2 m tall. **Bark** smooth, brownish. **Sapwood** brownish. **Twigs** sparsely appressed tomentose, smooth or sparsely lenticellate. **Leaves** *thin-coriaceous*, *glabrescent above*, *sparsely brownish or greyish appressed tomentose below*; elliptic to oblong, *(11–)16–22(–23) × (4.5–)5–7.5 cm*, base attenuate, acute or cuneate, margin slightly revolute, *apex acuminate*, *acumen 5–10 mm long*; midrib slightly raised above, strongly raised below; lateral veins thin, (6–)8–10(–18) pairs, lax, slightly raised or impressed or flat above, strongly raised below, disappearing near the leaf margin, forming an angle of 30–45° with the midrib; *intercostal venation subscalariform*, lax, *obscure on both surfaces or thinly prominent below*; *petiole 6–18 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 20–25 cm long; bracts ovate, 0.8–1 × 0.3–0.6 mm; bracteoles broadly ovate, *c.* 0.5 mm across. **Male flowers** solitary along the rachis; perianth lobes obtuse, 1–1.5 × 1 mm; stamen filaments *c.* 2 mm long; pistillode subglobose, 0.5–0.8 mm diameter. **Androgynous inflorescences** 11–26 cm long; bracts and bracteoles ovate, *c.* 1 × 0.3–0.6 mm. **Female flowers** solitary along the rachis; perianth lobes acute, 0.8–1 × 0.3–0.7 mm; staminodes 10; styles conical, straight, *c.* 2 mm long. **Cupules** solitary along the rachis, *sessile*, saucer-shaped, 0.6–1 × 2.2–3.2 cm, densely tomentose, *echinulate*; wall woody, thick, enclosing less than half of the acorn; *short and slender prickles* or *spine-like appendages distinct*, *straight or recurved, sharp-tipped*, densely but irregularly set. **Acorns** depressed globose, 1.3–2.5 × 2.2–3.3 cm, *most part exserted*, *sparsely tomentose with simple hairs*, brown; base rounded, apex abruptly rounded-apiculate; scar flat to concave, *2.3–2.6 cm diameter*; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Endemic to Borneo. In Sarawak, uncommon, known from Dulit Range in Belaga district and Sg. Joh and Ulu Katibas in Kapit district. So far there is no record for Sabah. Also in Kalimantan.

Ecology. In lowland to hill mixed dipterocarp forests on igneous and clay soils, usually along riverbanks, up to 400 m altitude.

20. **Lithocarpus elegans** (Blume) Hatus. *ex* Soepadmo

(Latin, *elegans* = elegant; the cupules and acorns)

Reinwardtia 8 (1970) 236, *l.c.* (1972) 366; Cockburn *l.c.* (1972) 219, *l.c.* (1976) 100; Anderson *l.c.* 200; Corner *l.c.* 340; Whitmore, Tantra & Sutisna *l.c.* 156; Turner *l.c.* (1995) 236; PROSEA *l.c.* 293; Coode *et al.* (eds.) *l.c.* 125. **Basionym:** *Quercus elegans* Blume, Verh. Batav. Gen. K. & W. 9 (1823) 208. **Type:** *Blume s.n.*, Java, Bantam Residency, Sadjira (holotype L; isotypes CGE, K, P). **Synonyms:** *Q. spicata* (*non* Humb. & Bonpl. 1809) Smith *in* Rees, Cyclop. (1814) 12; *Q. racemosa* (*non* Lam. 1783) Jack, Mal. Misc. 2 (1822) 86; *Q. arcaula* Hamilt. *ex* G. Don var. *racemosa* (Jack) Blume *l.c.* (1850) 290; *Q. spicata* (*non* Humb. & Bonpl.) Smith var. *racemosa* (Jack) Miq., Ann. Mus. Lugd.-Bat 1 (1863) 106; *Q. depressa* Blume *l.c.* (1823) 209, *t.* 1; *Q. spicata* (*non* Humb. & Bonpl.) Smith var. *depressa* (Blume) King, Ann. Roy. Bot. Gard. Calc. 2 (1889) 48, *t.* 43; *Q. glaberrima* Blume *l.c.* (1823) 210, *t.* 2; *Q. spicata* (*non* Humb. & Bonpl.) Smith var. *glaberrima* (Blume) Miq. *l.c.* (1856) 848; *L. spicata* (Smith) Rehder var. *glaberrima* (Blume) A. Camus *l.c.* (1949) 103, *t.* 482; *L. spicata* (Smith) Rehder var. *elegans* (Blume) A. Camus *l.c.* (1949) 102, *t.* 481; *Q. placentaria* Blume, *l.c.* (1825) 518; *Q. spicata* (*non* Humb. & Bonpl.) Smith var. *placentaria* (Blume) Schottky *l.c.* (1912) 664; *Q. grandifolius* D. Don *in* Lamb., Gen. Pin. 2 (1824) 27, *t.* 8; *L. grandifolius* (D. Don) S.N. Biswas, Bull. Bot. Surv. India 10 (1968) 258; *P. spicata* (Smith) Oerst. var. *placentaria* (Blume) Oerst. *l.c.* (1867) 83; *Pasania spicata* (Smith) Oerst. var. *placentaria* (Blume) Schottky *l.c.* (1912) 664; *L. spicata* (Smith) Rehder var. *placentaria* (Blume) Rehder *l.c.* (1929) 133; *Q. glomerata* Roxb., Fl. Ind. 3 (1832) 640; *P. glomerata* (Roxb.) Oerst. *l.c.* (1891) 379; *Q. anceps* Korth. *l.c.* (1844) 204; *Q. microcalyx* Korth. *l.c.* (1844) 206; *Q. arcaula* Hamilt. *ex* G. Don var. *microcalyx* (Korth.) Blume *l.c.* (1850) 290; *Q. spicata* (*non* Humb. & Bonpl.) Smith var. *microcalyx* (Korth.) Miq. *l.c.* (1856) 848; *P. spicata* (Smith) Oerst. var. *microcalyx* (Korth.) Gamble *l.c.* (1915) 421; *L. microcalyx* (Korth.) A. Camus *l.c.* (1945) 83; *Q. pyrifolia* Blume *l.c.* (1850) 304; *Q. sphacelata* Blume *l.c.* (1850) 304; *Q. gracilipes* Miq., Fl. Ned. Ind. 4, Suppl. (1861) 347; *Q. spicata* (*non* Humb. & Bonpl.) Smith var. *gracilipes* (Miq.) Miq. *l.c.* (1863) 106; *P. spicata* (Smith) Oerst. var. *gracilipes* (Miq.) Schottky *l.c.* (1912) 664; *L. spicata* (Smith) Rehder var. *gracilipes* (Korth.) Rehder *l.c.* (1919) 131; *Q. spicata* (*non* Humb. & Bonpl.) Smith var. *latifolia* Scheff. *l.c.* (1870) 359; *Q. rhioensis* Hance *l.c.* 198; *L. rhioensis* (Hance) A. Camus *l.c.* (1932) 40.

Tree up to 30 m tall, 70 cm diameter. **Bark** deeply fissured or lenticellate, greyish brown; inner bark granular, reddish or brownish. **Sapwood** yellowish or brownish. **Twigs** sparsely tomentose, late-glabrescent, sparsely to densely large-lenticellate. **Stipules** ovate to linear, 3–6 × 1–2 mm. **Leaves** coriaceous, rarely thick-coriaceous, *glabrous on both surfaces;* narrowly to broadly obovate or elliptic, (9–)12–17(–21) × 3–6(–8) cm, *base acute or cuneate*, margin revolute, apex bluntly acute or acuminate, acumen 10–15(–20) mm long;

midrib raised on both surfaces; *lateral veins* thin, (11–)13–16(–18) pairs, lax, slightly raised or flat or sometimes impressed above, raised below, *faintly joining near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation subscalariform or rarely reticulate*, lax, *obscure above*, *prominent below*; *petiole 7–15 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 10–20 cm long; bracts ovate, *c.* 1.5 × 1 mm; bracteoles elliptic, *c.* 0.5 × 0.2 mm. **Male flowers** solitary but closely arranged along the rachis; perianth lobes rounded, 1–1.2 mm across; stamens filaments *c.* 2 mm long; pistillode globose, *c.* 1 mm diameter. **Androgynous** or **mixed inflorescences** 12–20 cm long; bracts and bracteoles broadly ovate, 1–1.3 × 0.9–1 mm. **Female flowers** in cluster of (2–)3–7(–10) along the rachis; perianth lobes acute, *c.* 0.7 × 0.5 mm; staminodes 12; styles cylindrical, straight, *c.* 1 mm long. **Cupules** in clusters 3–7 or rarely solitary along the rachis, sessile or with stalk *c.* 5 mm long, cup-shaped, 1–1.5 × (1–)2–2.5(–3) cm, densely appressed tomentose, *scaly*; wall woody, thin, enclosing up to half of the acorn; scale-like appendages distinct, appressed, woody, imbricate, set in regular lines. **Acorns** *ovoid or depressed ovoid to subglobose*, (1–)1.5–2(–2.3) × (1–)2–2.5(–3) cm, *most part exserted*, *glabrous*, brownish; base flat, apex rounded; scar flat or concave, 1–1.5 cm diameter; *wall woody*, *thin*, *most part free from the cupule.*

Vernacular names. Sabah—*tihaig* (Dusun, Banggi). Sarawak—*berungulad* (Kelabit).

Distribution. India, Burma, Thailand, Laos, Cambodia, Vietnam, China, Sumatra, Peninsular Malaysia, Singapore, Java, Borneo, and Sulawesi. Common and widespread throughout Sabah. In Sarawak, uncommon, only known from Sg. Menalio in Marudi district and G. Gading in Lundu district. Also in Kalimantan.

Ecology. In hill mixed dipterocarp forest to lower montane forest, up to 1500 m altitude, on a variety of soils.

Uses. The wood is used locally as firewood and for making charcoal. The acorns are edible but rarely eaten.

21. **Lithocarpus encleisacarpus** (Korth.) A. Camus

(Greek, *enkleiein* = enclosed, *karpos* = fruit; with acorn completely enclosed by the cupule)

Riviera Scientific 18 (1932) 40; Soepadmo *l.c.* (1970) 239, *l.c.* (1972) 338; Cockburn *l.c.* (1972) 219, *l.c.* (1976) 99; Anderson *l.c.* 200; Corner *l.c.* 240; Whitmore, Tantra & Sutisna *l.c.* 156; Turner *l.c.* 236; PROSEA *l.c.* 294. **Basionym:** *Quercus encleisacarpus* Korth. Kruidk. (1844) 209. *t.* 45. **Type:** *Korthals s.n.* (= *RHL Sheet No. 901310172*), C Sumatra, Mt. Melintang (holotype L; isotypes A, K, P). **Synonyms:** *Cyclobalanus encleisocarpa* (Korth.) Oerst. *l.c.* (1867) 81; *Pasania encleisocarpa* (Korth.) Gamble *l.c.* (1915) 449; *Synaedrys encleisocarpa* (Korth.) Koidzumi *l.c.* 186; *Castanopsis encleisocarpa* (Korth.) Rehder *l.c.* (1919) 122.

Tree up to 40 m tall, 75 cm diameter. **Bark** smooth or scaly and sparsely lenticellate, greyish brown; inner bark yellowish. **Sapwood** whitish. **Twigs** densely tomentose with appressed stellate hairs, late-subglabrescent, sparsely lenticellate. **Leaves** thin-coriaceous, *glabrous above*, *sparsely appressed yellowish or brownish tomentose below*; elliptic or ovate, (7–)12–15 × (–2)4–6 cm, *base symmetrical*, *acute* or obtuse, rarely rounded, *margin not undulate*, *weakly revolute*, apex acute to acuminate, acumen (5–)10–15 mm long;

midrib slightly raised or impressed above, raised below; *lateral veins thin*, *(7–)8–10 (–12) pairs*, *lax*, flat or impressed above, thinly raised below, *faintly joining near the leaf margin*, forming an angle of 40–70° with the midrib; *intercostal venation* subscalariform or irregular, *dense*, obscure above, prominent below; *petiole 5–15 mm long*. **Inflorescences** male, female or androgynous. **Male inflorescences** 6–13 cm long; bracts rounded or broadly ovate, 0.4–0.5 × 0.3–0.5 mm; bracteoles broadly obovate, *c.* 0.3 × 0.5 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 1 × 0.7 mm; stamen filaments *c.* 2 mm long; pistillode globose, 1–1.2 mm diameter. **Female** or **androgynous inflorescences** 10–20 cm long; bracts rounded, 0.4–0.5 mm across; bracteoles ovate, *c.* 0.4 × 0.2 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 0.3 × 0.2 mm; staminodes 10–12; styles cylindrical, straight, *c.* 1.5 mm long. **Cupules** solitary but arranged closely together along the rachis, with stalk 10–15 mm long, *deeply cup-shaped to almost completely covering the acorn*, 1.5–2.5 × 2–3 cm, tomentose, *lamellate*; wall bony, thin, densely hairy; lamellae slightly distinct, edge minutely denticulate or entire, set in 5–7 regular lines. **Acorn** *depressed ovoid to subglobose*, 1.5–2 × 1.5–3 cm, *free part densely yellowish simple hairy or velvety*, dark brown; base rounded, apex acute; *scar shallowly concave*, *1–1.5 cm diameter*; *wall bony*, *thin*, *most part free from the cupule.*

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah, known from Ranau, Tawau, Sandakan, and Beaufort districts. In Sarawak, known mainly from Kapit, Kuching, Miri, and Limbang districts. Also in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp forest to lower montane forest, at 1000–1500m altitude.

Uses. The timber is locally used for house construction and as firewood. The bark contains tannin which is used for dyeing cotton and rattans.

22. **Lithocarpus ewyckii** (Korth.) Rehder

(D.J. van Ewijck van Oostbroek en De Bilt, 1786–1858, officer of the Dutch Colonial Service)

J. Arn. Arb. (1929) 132; Soepadmo *l.c.* (1970) 240, *l.c.* (1972) 351; Cockburn *l.c.* (1972) 220, *l.c.* (1976) 108; Anderson *l.c.* 200; Whitmore, Tantra & Sutisna *l.c.* 156; Turner *l.c.* 236; PROSEA *l.c.* (1995) 294; Coode *et al.* (eds.) *l.c.* 125; Kochummen *l.c.* 248; Argent *et al.* (eds.) *l.c.* 248. **Basionym:** *Quercus ewyckii* Korth., Kruidk. (1844) 212. **Type:** *Korthals s.n. (= RHL Sheet No. 901310184*), Central Sumatra, Mt. Melintang (holotype L; isotypes A, BM, NY, P). **Synonyms:** *Cyclobalanus ewyckii* (Korth.) Oerst. *l.c.* (1867) 80; *Pasania ewyckii* (Korth.) Gamble *l.c.* (1915) 431; *Synaedrys ewyckii* (Korth.) Koidzumi *l.c.* (1916) 191; *P. lamponga* (Miq.) Gamble var. *ewyckioides* Gamble *l.c.* 425; *L. pseudolamponga* A. Camus *l.c.* (1954) 110, *t.* 504.

Tree up to 50 m tall, 90 cm diameter. **Bark** smooth or scaly, greyish brown to reddish brown; inner bark fibrous, brownish. **Sapwood** brownish. **Twigs** subglabrous, sparsely lenticellate or smooth. **Stipules** linear, 4–5 × 1 mm. **Leaves** *thin-coriaceous*, *subglabrous above*, *sparsely appressed yellowish tomentose with simple hairs below*; *elliptic or ovate*, (6–)9.5–13(–15) × (2.5–)3–6(–7) cm, *base rounded or obtuse*, *margin not undulate*, *revolute*, apex bluntly to sharply acuminate, acumen (5–)10–20 mm long; *midrib faintly raised on both surfaces*, stronger below; *lateral veins* thin, *(12–)13–15(–16) pairs*, dense, flat or sometimes obscure above, raised below, disappearing or faintly joining near the leaf margin, *forming an angle of 45–60° with the midrib*; *intercostal venation scalariform*, *dense*, *obscure above*, *prominent below*; *petiole 5–15(–24) mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 10–18 cm long; bracts and bracteoles ovate, *c.* 0.5 × 0.3 mm. **Male flowers** solitary or in clusters of 2–3 along the rachis; perianth lobes acute, *c.* 1.2 × 1 mm; stamen filaments 2–3 mm long; pistillode globose, *c.* 0.7 mm diameter. **Androgynous** or **mixed inflorescences** 5–10 cm long; bracts and bracteoles ovate, 1–1.2 × 0.5–0.6 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 0.7 × 0.5 mm; staminodes 12; styles conical, slightly recurved, *c.* 1 mm long. **Cupules** solitary along the rachis, *with stalk 5–10 mm long*, *cup-shaped*, *0.4–1 × 2–2.5 cm*, sparsely tomentose, *lamellate*; wall woody, thick, sparsely hairy, enclosing less than half of the acorn; *lamellae distinct*, *edge entire*, set in 6–7 regular lines. **Acorns** conical to ovoid, 1.7–2.3 × 1.5–2.5 cm, *most part exserted*, *glabrous*, brownish; base rounded, apex abruptly acute; scar deeply concave, 1–1.5 cm diameter; *wall bony*, *thick*, *most part free from the cupule.*

Vernacular names. Sarawak—*salad repak* (Kelabit), *ta'alan* (Punan).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. Very common and widespread throughout Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp forest, including *kerangas* forest, to montane forest, at 200–2000 m altitude, on sandy loam and clay soils.

23. **Lithocarpus ferrugineus** Soepadmo

(Latin, *ferrugineus* = red-brown; the indumentum of the acorn)

Reinwardtia 8 (1970) 242, *l.c.* (1972) 370; Cockburn *l.c.* (1976) 100; Anderson *l.c.* 200; Whitmore, Tantra & Sutisna *l.c.* 156; Coode *et al.* (eds.) *l.c.* 126; Argent *et al.* (eds.) *l.c.* 248. **Type:** *Ilias S. 17030*, Borneo, Sarawak, Serian district, Sabal FR (holotype L; isotypes A, BO, K, KEP, M, P, S, SAN, SAR, SING).

Tree up to 30 m tall, 50 cm diameter; buttresses *c.* 0.7 m tall. **Bark** scaly or smooth or lenticellate, greyish brown; inner bark fibrous, brownish or reddish. **Sapwood** yellowish. **Twigs** sparsely tomentose, finely fissured or sparsely lenticellate. **Leaves** thin-coriaceous to coriaceous, *glabrous on both surfaces*; lanceolate, oblanceolate, elliptic or oblong, (12–)16–22.5(–30) × (3–)4.5–6.5(–9) cm, *base obtuse or rounded*, margin revolute, apex abruptly acute to acuminate, acumen 10–15 mm long; midrib slightly raised above, strongly raised below; *lateral veins* thick, (8–)9–13(–14) pairs, lax, impressed or flat above, raised below, *faintly joining near the leaf margin*, forming an angle of 30–50° with the midrib; *intercostal venation subscalariform or irregular*, lax, *obscure above*, *prominent below*; *petiole (6–)7–15(–18) mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 10–20 cm long; bracts and bracteoles ovate, 0.5–1.2 × 0.3–0.8 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1.2 × 1.5 mm; stamen filaments *c.* 2 mm long; pistillode subglobose, 0.8–1 mm diameter. **Androgynous** or **mixed inflorescences** 10–15 cm long; bracts ovate, *c.* 1.2 × 1 mm; bracteoles obtuse, 0.2–0.3 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1 × 0.8 mm; staminodes 12; styles conical, straight, *c.* 1.5 mm long. **Cupules** solitary along the rachis, subsessile, cup- or saucer-shaped, 0.5–1 × 1.2–2 cm, densely appressed tomentose with stellate hairs, *scaly*; wall woody, thin, enclosing up to half of the acorn; scale-like appendages distinct, appressed, imbricate, irregularly set. **Acorns** *ovoid*, *1.5–2 × 1.5–2.3 cm*, *most part exserted*, *densely reddish brown tomentose with simple*, *long and stellate hairs*; base rounded, apex obtuse; scar deeply concave, *c.* 1 cm diameter; *wall woody*, *thin*, *most part free from the cupule.*

Distribution. Peninsular Malaysia and Borneo. Very common and widespread throughout Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp forest to lower montane forest, up to 1200 m altitude, on sandy clay and yellow podsolic soils.

24. **Lithocarpus gracilis** (Korth.) Soepadmo

(Latin, *gracilis* = slender; the twig)

Reinwardtia 8 (1970) 243, *l.c.* (1972) 362; Cockburn *l.c.* (1972) 220, *l.c.* (1976) 110; Anderson *l.c.* 201; Whitmore, Tantra & Sutisna *l.c.* 157; Turner *l.c.* 236; Kessler & Sidiyasa *l.c.* 141; PROSEA *l.c.* (1995) 294; Coode *et al.* (eds.) *l.c.* 126; Argent *et al.* (eds.) *l.c.* 248. **Basionym:** *Quercus gracilis* Korth. *l.c.* 207. **Type:** *Korthals s.n. (= RHL Sheet No 901310314),* Borneo, Kalimantan, Balaran (holotype L; isotypes A, P). **Synonyms:** *Cyclobalanus gracilis* (Korth.) Oerst. *l.c.* (1871) 376; *Q. cyrtorhyncha* Miq. *l.c.* (1861) 350; *Pasania cyrtorhyncha* (Miq.) Gamble *l.c.* (1915) 432; *Synaedrys cyrtorhyncha* (Miq.) Koidzumi *l.c.* 191; *L. cyrtorhyncha* (Miq.) Rehder *l.c.* (1919) 124; *Q. diepenhorstii* Miq. *l.c.* (1861) 349; *Cyclobalanus diepenhorstii* (Miq.) Oerst. *l.c.* (1867) 80; *S. diepenhorstii* (Miq.) Koidzumi *l.c.* 191; *L. diepenhorstii* (Miq.) Barnett *l.c.* (1944) 177; *L. cyathiformis* A. Camus *l.c.* (1947) 4.

Tree up to 40 m tall, 90 cm diameter; buttresses up to 1.5 m tall. **Bark** smooth or fissured or scaly, greyish brown; inner bark fibrous, brownish or yellowish. **Sapwood** yellowish brown. **Twigs** sparsely tomentose, late-glabrescent, sparsely lenticellate or smooth. **Stipules** linear, 2–4 × 1 mm. **Leaves** *thin-coriaceous*, *glabrous above*, *sparsely brownish appressed tomentose below*; *elliptic*, *oblong or ovate*, (8–)12.5–15.5(–18) × (4–)4.5–6.5(–7) cm, *base obtuse to cordate*, *margin revolute*, *often undulate*, apex bluntly acute to acuminate, acumen 10–15 mm long; *midrib faintly raised on both surfaces*, stronger below; *lateral veins* thin, (12–)13–17(–19) pairs, dense, raised on both surfaces or flat above, faintly joining near the leaf margin, *forming an angle of 30–45(–60°) with the midrib*; *intercostal venation subscalariform to irregular*, *dense*, *obscure above*, *prominent below*; *petiole (3–)5–7 (–8) mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 10–20 cm long; bracts narrowly ovate to linear, *c.* 1.2 × 0.3 mm; bracteoles narrowly ovate, *c.* 0.7 × 0.3 mm. **Male flowers** in clusters of 3–5 along the rachis; perianth lobes obtuse, *c.* 0.9 × 0.7 mm; stamen filaments 2–3 mm long; pistillode subglobose, 0.8–1 mm diameter. **Androgynous** or **mixed inflorescences** 12–20 cm long; bracts linear, *c.* 1.2 × 0.3 mm; bracteoles narrowly ovate, *c.* 0.4 × 0.2 mm. **Female flowers** solitary or in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 0.6 × 0.3 mm; staminodes 12; styles cylindrical, straight, 0.7–1 mm long. **Cupules** solitary, rarely in clusters of 3 along the rachis, sessile or with stalk *c.* 5 mm long, saucer- to cup-shaped, 0.5–1 × 1.8–2.5 cm, densely tomentose with simple hairs, *lamellate*; wall bony, thin, enclosing less than half of the acorn; *lamellae slightly distinct*, *edge dentate*, set in 6–8 regular lines. **Acorns** ovoid to conical, 1.5–1.8(–2) × 1.5–2.5 cm, *most part exserted*, *glabrous*, brown; base rounded, apex abruptly acute; scar shallowly concave or flat, 0.8–1.5 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Vernacular names. Sabah—*diparak*, *tikalod* (Dusun, Banggi). Sarawak—*saled* (Kelabit), *tekalat* (Kayan), *tekalat uak* (Kenyah).

Distribution. Sumatra, Peninsular Malaysia and Borneo. Common and widespread throughout Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary or secondary hill mixed dipterocarp forest, including riparian and *kerangas* forests, up to 1200 m altitude, on sandy-clay and alluvium soils.

Use. The wood is used locally for general construction.

25. **Lithocarpus hallieri** (Seemen) A. Camus

(J.G. Hallier, 1868–1932, sometime research assistant at the Herbarium Bogoriense, Bogor, and Rijksherbarium, Leiden)

Riviera Scientific 18 (1932) 40; Soepadmo *l.c.* (1970) 244, *l.c.* (1972) 327; Cockburn *l.c.* (1976) 103; Anderson *l.c.* 201; Whitmore, Tantra & Sutisna *l.c.* 157; PROSEA *l.c.* 295; Argent *et al.* (eds.) *l.c.* 248. **Basionym:** *Quercus hallieri* Seemen, Bull. Dépt. Agr. Ind. Néerl. 1 (1906) 189. **Type:** *Hallier 2655*, Borneo, Kalimantan, Mt. Lianggagang (holotype BO; isotype L). **Synonym:** *Synaedrys hallieri* (Seemen) Koidzumi *l.c.* 189.

Tree up to 45 m tall, 90 cm diameter. **Bark** smooth or flaky, sometimes lenticellate, greyish brown; inner bark granular, yellowish or brownish. **Sapwood** brownish. **Twigs** glabrous, smooth or sparsely minute-lenticellate. **Leaves** *thick-coriaceous*, *glabrous on both surfaces* or glabrous above and sparsely tomentose beneath; elliptic to oblong, *15–20(–24) × 7–9(–10) cm*, base rounded, acute to cuneate, margin revolute, apex acute or acuminate, acumen *c.* 10 mm long; midrib raised on both surfaces, stronger below; lateral veins thin, 6–11 pairs, lax, flat above, raised below, faintly joining near the leaf margin, forming an angle of 45–60º with the midrib; *intercostal venation subscalariform*, dense, obscure above, thinly prominent below, or obscure on both surfaces; *petiole 15–30 mm long*. **Inflorescences** male, female and androgynous. **Male inflorescences** 20–26 cm long; bracts linear, 2–2.5 × 0.5 mm; bracteoles ovate, *c.* 0.8 × 0.6 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes obtuse, 1.5–2 × 1 mm; stamen filaments 1.5–3.5 mm long; pistillode subglobose, *c.* 1 mm diameter. **Female** or **androgynous inflorescences** 10–15 cm long; bracts broadly ovate, *c.* 1 mm across; bracteoles subrounded, *c.* 0.5 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1.5 × 1 mm; staminodes 12; styles conical, straight, *c.* 1 mm long. **Cupules** solitary along the rachis, sessile or with stalk *c.* 10 mm long; *obovoid to subglobose*, 4–7 cm diameter, sparsely tomentose, *lamellate*; wall woody, thick, sparsely hairy, *completely enclosing the acorn except for an apical opening c. 0.5 cm diameter*; lamellae obscure or slightly distinct, edge entire, set in 4–5 irregular or rarely regular lines. **Acorns** subglobose, 3–4.5 × 4–4.5 cm, free apical part sparsely tomentose, brown; base rounded, apex flat; *wall woody, thick, most part adnate to the cupule.*

Vernacular names. Sarawak—*keraki* (Iban), *salad* (Kelabit), *saled kup* (Murut).

Distribution. Endemic to Borneo. In Sabah, very common in Ranau (especially in Kinabalu

Park), Kota Belud, Penampang, Tenom, Keningau, and Beaufort districts. In Sarawak, known from Kapit, Miri and Kuching districts. Also in Kalimantan.

Ecology. In primary lowland mixed dipterocarp forest to montane forest on clay soils, at 400–2600 m altitude.

26. **Lithocarpus hatusimae** Soepadmo

(S. Hatusima, 1943–1945 Head of the Herbarium Bogoriense, Bogor, later Professor at Kagoshima College, Faculty of Agriculture, Kyushu, Japan)

Reinwardtia 8 (1970) 244, *l.c.* (1972) 358; Cockburn *l.c.* (1976) 97; Anderson *l.c.* 201; Whitmore, Tantra & Sutisna *l.c.* 157. **Type:** *Clemens 29206*, Borneo, Sabah, Mt. Kinabalu (holotype L; isotypes A, BM, K, NY, UC).

Tree up to 20 m tall, 35 cm diameter. **Bark** smooth or fissured, greyish brown; inner bark fibrous, brownish. **Sapwood** yellowish or brownish. **Twigs** densely appressed tomentose, sparsely or rarely densely lenticellate. **Stipules** linear, *c.* 3 × 1 mm. **Leaves** *thick-coriaceous, rigid*, subglabrous or sparsely appressed tomentose above, *sparsely brownish or yellowish appressed tomentose below*; elliptic or ovate, *(5.5–)8.5–11.5(–18) × (2.5–)4.5–6(–7.5) cm*, base acute or cuneate, rarely rounded, *margin strongly revolute*, *apex sharply acuminate*, *acumen 10–20 mm long*; midrib broad, strongly raised on both surfaces; *lateral veins* thick, (7–)10–12(–13) pairs, *dense*, impressed or flat above, strongly raised below, faintly joining near the leaf margin, forming an angle of 40–70° with the midrib; *intercostal venation subscalariform*, dense, *obscure on both surfaces or thinly prominent below*; *petiole (8–)9–13(–20) mm long*. **Inflorescences** male, female, androgynous or mixed. **Male inflorescences** 10–12 cm long; bracts and bracteoles ovate, *c.* 0.8 × 0.4 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1 × 0.4 mm; stamen filaments *c.* 2 mm long; pistillode subglobose, 0.5–0.8 mm diameter. **Female, androgynous** or **mixed inflorescences** 5–10 cm long; bracts broadly ovate, 0.2–0.3 mm across. **Female flowers** solitary or in clusters of 2–3 along the rachis; perianth lobes acute, 0.3–0.4 mm across; staminodes 10; styles conical, straight, *c.* 1.5 mm long. **Cupules** solitary or rarely in clusters of 2 along the rachis, with stalk 3–5 mm long, cup-shaped, 0.5–0.9 × 1.2–1.8 cm, densely appressed tomentose, *lamellate*; wall woody, thin, enclosing less than half of the acorn; lamellae distinct, edge minutely denticulate, set in 5–6 regular lines. **Acorns** ovoid to conical, 1–2 × 1.2–2.2 cm, *most part exserted*, glabrous except for the densely tomentose small part at the apex, dark brown; base rounded to cordate, apex abruptly acute; scar concave, *c.* 1 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Vernacular name. Sarawak—*salad* (Murut).

Distribution. Endemic to Borneo. In Sabah, common in Ranau and Sipitang districts. In Sarawak, documented from Miri (common in G. Mulu area), Limbang, Sri Aman, Kapit, and Kuching districts. Also in Brunei and Kalimantan.

Ecology. In primary and secondary hill mixed dipterocarp forest, including *kerangas* forest, to montane forest, at 800–2200 m altitude, mainly on clay soils.

27. **Lithocarpus havilandii** (Stapf) Barnett

(J.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Trans. & Proc. Bot. Soc. Edinb. 33 (1942) 176; Soepadmo *l.c.* (1970) 245, *l.c.* (1972) 373; Cockburn *l.c.* (1976) 97; Anderson *l.c.* 201; Whitmore, Tantra & Sutisna *l.c.* 157. **Basionym:** *Quercus havilandii* Stapf, FMK (1894) 231, *t.* 18. **Type:** *Haviland 1069*, Borneo, Sabah, Mt. Kinabalu (holotype K; isotypes BM, SING). **Synonyms:** *Q. abendanonii* Valeton, Icon. Bog. 4 (1914) 179, *t.* 354; *L. abendanonii* (Valeton) A. Camus *l.c.* (1945) 84.

Tree up to 25 m tall, 40 cm diameter. **Bark** smooth or scaly or lenticellate, greyish brown; inner bark fibrous, reddish or brownish. **Sapwood** reddish or whitish. **Twigs** densely or sparsely tomentose with stellate and simple hairs, smooth. **Stipules** ovate, *c.* 3 × 1 mm. **Leaves** coriaceous to thick-coriaceous, rigid, *sparsely stellate-hairy or subglabrous above*, *densely brownish stellate-hairy below*; elliptic or ovate, *(4.5–)5.5–7.5(–9.5) × (2.5–)3–4 (–5) cm*, base broadly acute, rounded, or rarely subcordate, margin strongly revolute, *apex acute or acuminate*, *acumen 5–10 mm long*; midrib raised on both surfaces, stronger below; *lateral veins* thick, (6–)7–12 pairs, lax, impressed above, raised below, *faintly joining or disappearing near the leaf margin*, forming an angle of 45–60° with the midrib; *intercostal venation subscalariform*, lax, obscure or prominent above, prominent below; *petiole (3–) 5–8 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 3–6 cm long; bracts and bracteoles narrowly ovate, 1–1.2 × 0.3–0.5 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1 × 0.5 mm; stamen filaments *c.* 2.5 mm long; pistillode globose, *c.* 1 mm diameter. **Androgynous inflorescences** 3–6 cm long; bracts narrowly ovate to linear, 1.2–3 × 0.5 mm; bracteoles ovate, *c.* 0.8 × 0.5 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 0.8 × 0.6 mm; staminodes 12; styles conical, recurved, *c.* 2 mm long. **Cupules** solitary along the rachis, *sessile*, cup-shaped, 0.3–0.5 × 1–1.5(–2) cm, densely appressed tomentose with stellate and simple hairs, *scaly*; wall bony, thin, enclosing less than half of the acorn; scale-like appendages distinct, irregularly set. **Acorns** ovoid to conical, 1.2–1.7(–2) × 1.5–2 cm, *most part exserted*, *glabrous except for the sparsely simple-hairy apex*, brownish; base flat, apex acute; scar flat or slightly concave, 0.5–1 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Distribution. Borneo and Sulawesi. In Sabah, common in Ranau and Tambunan districts. In Sarawak, only known from Sg. Badas Sirau and Ba’ Kelalan in Lawas district. Also in Kalimantan.

Ecology. Common on ridge tops in primary lower and upper montane forests, at 1300–2500 m altitude.

28. **Lithocarpus hystrix** (Korth.) Rehder

(Latinised Greek, *hystrix* = set with slender prickles; the cupule)

J. Arn. Arb. 1 (1919) 127; Soepadmo *l.c.* (1970) 246, *l.c.* (1972) 384; Corner *l.c.* 340; Whitmore, Tantra & Sutisna *l.c.* 157; Turner *l.c.* 236; PROSEA *l.c.* 295; Coode *et al.* (eds.) *l.c.* 126. **Basionym:** *Quercus hystrix* Korth. *l.c.* 201, *t.* 43. **Type:** *Korthals s.n.,* Sumatra (holotype L; isotypes A, K, P). **Synonyms:** *Q. korthalsii* Blume var. *hystrix* (Korth.) Blume, Mus. Bot. Lugd.-Bat. 1 (1850) 293; *Q. mappacea* Korth. var. *hystrix* (Korth.) Miq. *l.c.* (1856) 869; *Cyclobalanus hystrix* (Korth.) Oerst. *l.c.* (1867) 81; *Pasania hystrix* (Korth.) Gamble *l.c.* (1915) 428; *Synaedrys hystrix* (Korth.) Koidzumi *l.c.*

(1916) 195; *Q. cyrtopoda* Miq. *l.c.* (1858) 869; *Cyclobalanus cyrtopoda* (Miq.) Oerst. *l.c.* (1867) 80; *L. cyrtopoda* (Miq.) A. Camus *l.c.* (1949) 74; *Castanea furfurella* Miq. *l.c.* (1861) 352; *Q. brevipetiolata* Scheff. *l.c.* (1870) 359.

Tree up to 36 m tall, 75 cm diameter. **Bark** scaly or lenticellate, brownish or reddish. **Twigs** densely stellate-hairy, smooth or sparsely minute-lenticellate. **Stipules** linear, *c.* 3 × 1 mm. **Leaves** thin-coriaceous, *densely tomentose with stellate and simple hairs above*, *densely or rarely sparsely appressed tomentose below*; *broadly lanceolate or obovate*, (8–)10.5–13.5(–16) × (2.5–)3–5.5(–6) cm, base rounded, margin revolute, apex acute to acuminate, acumen 5–15 mm long; midrib raised on both surfaces, stronger below; lateral veins thin, 10–12(–15) pairs, dense, slightly raised or flat above, raised below, disappearing or faintly joining near the leaf margin, forming an angle of 40–60° with the midrib; *intercostal venation scalariform*, dense, obscure above, slightly prominent below; *petiole 3–5 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 5–11 cm long; bracts and bracteoles narrowly ovate to linear, 0.5–1.2 × 0.2–0.5 mm. **Male flowers** in clusters of 2–3 along the rachis; perianth lobes obtuse, *c.* 1 × 0.8 mm; stamen filaments *c.* 2 mm long; pistillode globose, 1–1.2 mm diameter. **Androgynous** or **mixed inflorescences** 7–17 cm long; bracts narrowly ovate, *c.* 1 × 0.3–0.5 mm; bracteoles broadly ovate, *c.* 0.7 × 0.5 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 0.7 × 0.5 mm; staminodes 10–12; styles conical, recurved, *c.* 1 mm long. **Cupules** solitary along the rachis, sessile, *saucer-shaped*, *0.7–1 × 1.8–2.5 cm*, densely tomentose; wall woody, thick, *enclosing less than half of the acorn*, *irregularly set with prickle-like*, *slender appendages*. **Acorns** ovoid to conical, 1.8–2 × 1.7–2 cm, *most part exserted*, *glabrous*, purplish; base rounded, apex acute; scar deeply concave, *c.* 1.3 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. So far not known in Sabah. In Sarawak, recorded for Miri, Kapit, Kuching, and Sri Aman districts. Also in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp forest to lower montane forest, at 300–1300 m altitude, on yellow sandy-clay soils.

Use. The bark contains tannin.

29. **Lithocarpus jacobsii** Soepadmo

(M. Jacobs, 1929–1983, former botanist at the Rijksherbarium, Leiden)

Reinwardtia 8 (1970) 248, *l.c.* (1972) 368; Anderson *l.c.* 201; Whitmore, Tantra & Sutisna *l.c.* 157; Coode *et al.* (eds.) *l.c.* 126; Argent *et al.* (eds.) *l.c.* 249. **Type:** *Jacobs 5398,* Borneo, Sarawak, Belaga district, Batang Rajang (holotype L; isotypes G, K, SAR, US).

Tree up to 36 m tall, 60 cm diameter. **Bark** smooth or lenticellate, brown; inner bark brownish. **Sapwood** whitish. **Twigs** sparsely tomentose with stellate hairs, smooth or sparsely large-lenticellate. **Stipules** linear, 5–10 × 1 mm. **Leaves** thick-coriaceous, *glabrous on both surfaces*; oblong or obovate, (17–)24–40(–56) × (4.5–)6–10.5(–16) cm, *base cordate to auriculate*, margin very strongly revolute, apex bluntly to sharply acute to acuminate, acumen *c.* 10 mm long; midrib broad, strongly raised on both surfaces; *lateral veins* thick, (10–)13–17(–19) pairs, lax, flat or impressed above, strongly raised below, *clearly joining near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation subscalariform to irregular*, lax, *obscure above*, *prominent below*; *petiole (4–)5–12(–15) mm long*. **Inflorescences** male and female. **Male inflorescences** 6–10 cm long; bracts broadly ovate, *c.* 1 × 0.8 mm; bracteoles narrowly ovate, *c.* 0.7 × 0.4 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes acute, 4–6 × 2–3 mm; stamen filaments *c.* 5 mm long; pistillode *c.* 5 mm diameter. **Female inflorescences** *c.* 25 cm long; bracts broadly ovate, *c.* 1 × 0.7 mm; bracteoles elliptic, *c.* 0.8 × 0.6 mm. **Female flowers** in clusters of 3 along the rachis; perianth lobes acute, 4–5 mm across; staminodes 12; styles conical, straight, 2–3 mm long. **Cupules** in clusters of 2–3 along the rachis and arranged closely together, with stalk *c.* 5 mm long, saucer-shaped, 0.2–0.7 × 2–2.5 cm, densely appressed tomentose with stellate hairs, *scaly*; wall woody, thick, enclosing less than half of the acorn; scale-like appendages slightly distinct, set in regular lines. **Acorns** *depressed ovoid to subglobose*, 1.5–2.5 × 2–2.8 cm, *most part exserted*, glabrous except for the sparsely simple-hairy apex, dark brown; base flat, apex rounded; scar deeply concave, 1–1.5 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Vernacular names. Brunei—*takalot* (Dusun), *tusuk pending memaluh* (Iban). Sarawak—*kalit* (Iban, Engkari), *saled arong* (Kelabit).

Distribution. Peninsular Malaysia and Borneo. In Sabah, only known from Sandakan district (Sepilok FR, Sg. Kun-Kun and Telupid). In Sarawak, known mainly from Kapit, Miri and Sri Aman districts. Also in Brunei and Kalimantan.

Ecology. In primary and secondary hill mixed dipterocarp forest to lower montane forest, up to 1300 m altitude, on sandy clay soils.

30. **Lithocarpus kalkmanii** S. Julia & Soepadmo

(C. Kalkman, 1928–1998; former Director of the Rijksherbarium, Leiden)

Gard. Bull. Sing. 50 (1998) 130. **Type:** *Meijer & Hendry SAN 42460,* Borneo, Sabah, Ranau district, Kinabalu Park, western border north of Sosopodon (holotype SAN; isotypes AA, K, L).

Tree up to 30 m tall, 60 cm in diameter. **Bark** large-lenticellate or cracked, brownish or greyish; inner bark reddish brown. **Sapwood** yellowish. **Twigs** sparsely brownish tomentose, late-glabrescent, smooth or sparsely large-lenticellate. **Leaves** *thick-coriaceous, sometimes rigid, densely appressed yellowish tomentose above, densely appressed greyish brown tomentose below*; broadly elliptic, *11–15.5 × 5–8 cm*, base acute, margin revolute, *apex acuminate*, *acumen 5–12 mm long*; midrib slightly raised above, strongly raised below; *lateral veins* thick, 12–14 pairs, *dense*, flat above, strongly raised below, disappearing near the leaf margin, forming an angle of 40–60° with the midrib; intercostal venation scalariform, dense, obscure above, slightly prominent below; *petiole 15–20 mm long*. **Inflorescences** and **flowers** unknown. **Cupules** solitary along the rachis, sessile, *subglobose*, *5–7 × 4–5.5 cm*, base rounded, apex flat, glabrous, *smooth*, *lamellate*; wall woody, thick, completely enclosing the acorn or with an apical opening 0.5–1 cm diameter; lamellae distinct, edge entire or minutely denticulate, especially the upper-most ones, set in 6–7 regular lines. **Acorns** subglobose, 4.5–6 × 3–5 cm, free apical part depressed at the centre, densely tomentose, dark brown; *wall woody*, *thick*, *most part adnate to the cupule*.

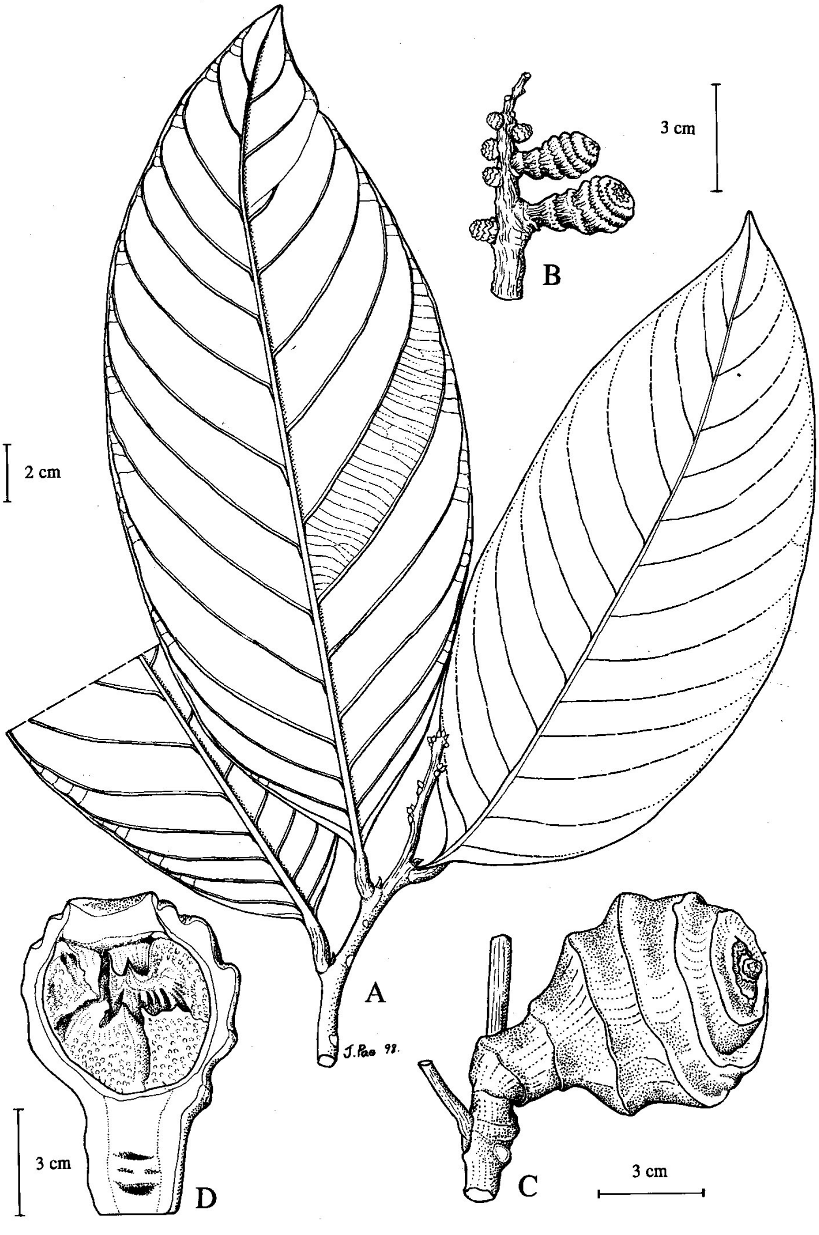

Fig. 10. *Lithocarpus keningauensis.* A, leafy twig; B, young infructescence; C, mature cupule; D, longitidunal section of mature cupule and acorn. (A and D from *SAN 50208*, B from *SAN 92174*, C from *SAN 95311*.)

Distribution. Endemic to Sabah. So far only known in Kinabalu Park and Sosopodon FR in Ranau district, and one collection from Nabawan in Keningau district.

Ecology. In primary hill mixed dipterocarp forest to lower montane forest, at 1000–1500 m altitude.

31. **Lithocarpus keningauensis** S. Julia & Soepadmo Fig. 10.

(of Keningau, Sabah)

Gard. Bull. Sing. 50 (1998) 132. **Type:** *Amin SAN 95311,* Borneo, Sabah, Keningau district, Bt. Kitau (holotype SAN; isotypes K, KEP, L, SAR).

Tree up to 30 m tall, 60 cm in diameter. **Bark** fissured to scaly, brown or reddish; inner bark brown or reddish. **Sapwood** yellowish to brownish. **Twigs** densely appressed tomentose, late-glabrescent, slightly fissured or sparsely large-lenticellate or smooth. **Leaves** *thick-coriaceous, rigid, glabrous or densely appressed yellowish tomentose above, densely appressed yellowish or brownish tomentose below*; elliptic to broadly elliptic, 12.5–16.5 (–29) × 4.5–7(–12.5) cm, base acute to cuneate, margin revolute, apex shortly acuminate, acumen *c.* 10 mm long; midrib broad, slightly raised above, strongly raised below; lateral veins thick, 12–14 pairs, lax, slightly raised or flat above, raised below, disappearing near the leaf margin, forming an angle of 45–60° with the midrib; *intercostal venation scalariform*, *dense*, obscure above, slightly prominent below; *petiole 10–15 mm long*. **Inflorescences** and **flowers** unknown. **Cupules** solitary along the rachis, sessile, *obovoid*, *7–11 × 5–6.5 cm*, base attenuate, apex flat and umbonate, glabrescent, *strongly lamellate*; wall woody, thick, *completely enclosing the acorn*; *lamellae distinct and prominent even in the young cupule*, *folded inwardly*, *longitudinally grooved*, set in 6–10 regular lines, raised from the cupule surface. **Acorns** obovoid, 4.5–6 × 3–5 cm, free apical part depressed and umbonate, densely tomentose, dark brown; *wall woody*, *thick*, *most part adnate to the cupule.*

Distribution. Endemic to Sabah. Known only from Ulu Biah, Bt. Kitau and Keningau trail in Keningau district.

Ecology. In primary and secondary forests on hill slopes, up to 300 m, on dark brown ultrabasic soils.

32. **Lithocarpus kochummenii** S. Julia & Soepadmo Fig. 11.

(K.M. Kochummen, 1931–1999, former senior forest botanist at the Forest Research Institute Malaysia, Kepong)

Gard. Bull. Sing 50 (1998) 134. **Type:** *Lee S. 38884,* Borneo, Sarawak, Miri district, G. Mulu NP (holotype SAR; isotypes K, KEP, SAN).

Tree up to 30 m tall, 60 cm in diameter; stilt-root up to 2 m high. **Bark** fissured or lenticellate, reddish brown. **Twigs** densely tomentose, late-glabrescent, sparsely to densely large-lenticellate. **Stipules** linear, 6–10 × 1 mm. **Leaves** thick-coriaceous, rigid, sparsely

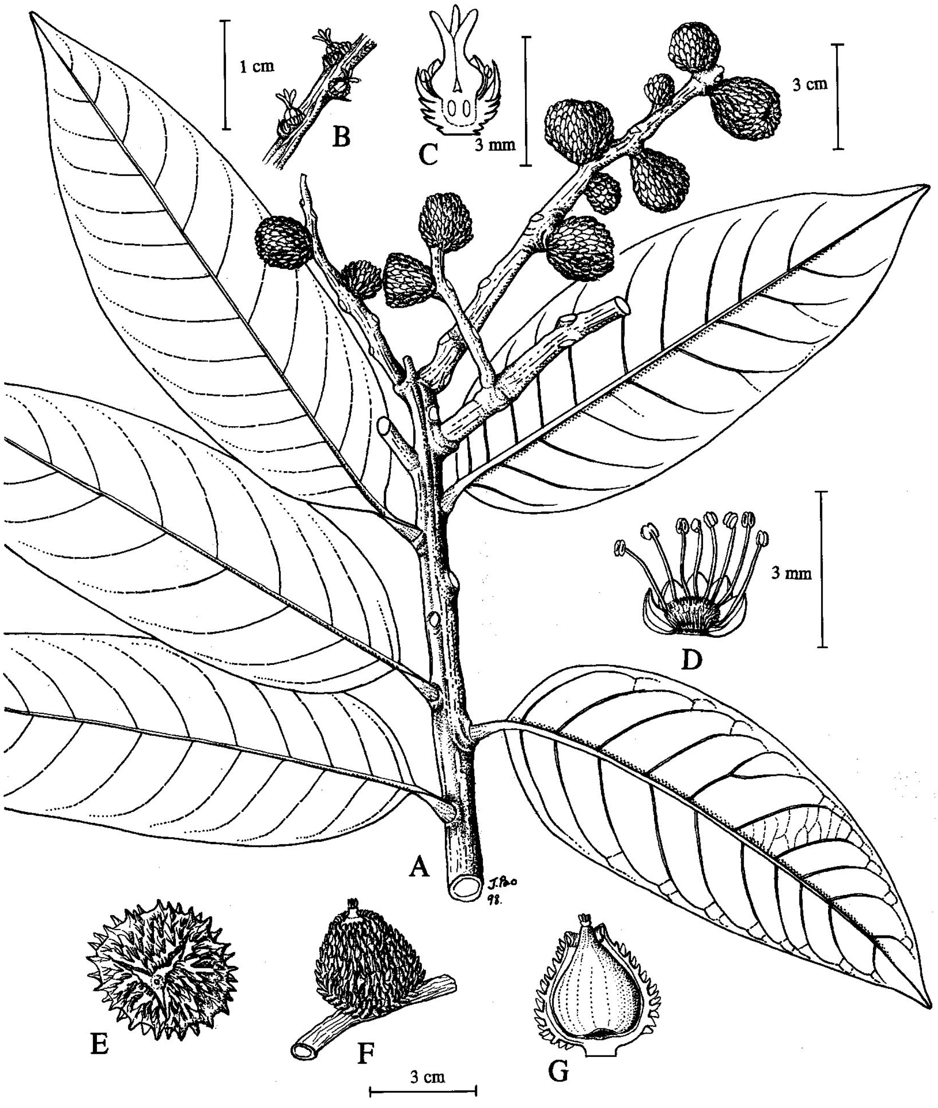

Fig. 11. *Lithocarpus kochummenii.* A, leafy fruiting twig; B, part of female inflorescence; C, longitidunal section of female flower; D, male flower with one perianth lobe removed; E, top view of cupule; F, side view of cupule; G, longitidunal section of cupule showing the free acorn. (A from *S. 4557*, B–D from *Kirkup DK 964*, E–G from *S. 38884*.)

appressed tomentose or glabrescent above, densely appressed brownish or yellowish tomentose below; *narrowly elliptic*, *lanceolate or oblanceolate*, (10–)14–18(–22) × (4–) 5–7(–8.5) cm, base acute, obtuse to rounded, margin strongly revolute, apex acute to acuminate, acumen 15–20 mm long; midrib broad, raised on both surfaces, stronger below; *lateral veins* thick, (11–)14–18(–20) pairs, *dense*, strongly impressed or rarely flat above, strongly raised below, *clearly joining near the leaf margin*, *forming an angle of 40–60° with the midrib*; intercostal venation thin, scalariform, rarely subscalariform, lax, obscure above, thinly prominent below; *petiole 5–10 mm long*. **Inflorescences** male, female or androgynous. **Male inflorescences** 5–13 cm long; bracts elliptic, 1.5–1.7 × 0.8 mm; bracteoles oblong, *c.* 0.5 × 0.2 mm. **Male flowers** solitary along the rachis; perianth lobes acute, *c.* 1.2 × 1 mm; stamen filaments 2–2.5 mm long; pistillode *c.* 1 mm in diameter**. Female** or **androgynous inflorescences** 7–15 cm long; bracts and bracteoles broadly ovate, 1–1.2 × 0.6–1 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1 × 0.8 mm; staminodes 10–12; styles conical, recurved, *c.* 2 mm long. **Cupules** solitary along the rachis, *sessile*, conical to ovoid, 2–2.5 cm across, densely tomentose with simple and stellate hairs; wall woody, thin, *completely enclosing the acorn*; *spine-like appendages distinct*, *broad and sturdy*, *straight or slightly recurved*, set irregularly. **Acorns** *conical*, 1.5–2 cm across, free part densely tomentose with simple hairs, rarely glabrous, brown; base flat, apex acute; scar deeply concave, 1.3–1.5 cm in diameter; *wall woody*, *thin*, *most part free from the cupule.*

Vernacular name. Sarawak—*salad* (Murut).

Distribution. Endemic to Borneo. So far not known in Sabah. In Sarawak, recorded for G. Mulu in Miri district, Ulu Sg. Kayan in Lundu district, Batu Lawi and Kota FR in Limbang district. Also in Brunei.

Ecology. In *kerangas*, riparian, to lower montane forests, at 900–1300 m altitude.

33. **Lithocarpus lampadarius** (Gamble) A. Camus

(Greek, *lampas* = torch; twigs are apparently used for torches in fishing by the Sakai tribe in Peninsular Malaysia)

Riviera Scientific 18 (1932) 41; Soepadmo *l.c.* (1970) 253, *l.c.* (1972) 368; Cockburn *l.c.* (1972) 222, *l.c.* (1976) 102; Anderson *l.c.* 201; Corner *l.c.* 341; Whitmore, Tantra & Sutisna *l.c.* 157; Turner *l.c.* 237; PROSEA *l.c.* 297. **Basionym:** *Pasania lampadaria* Gamble, Kew Bull. (1914) 177. **Type:** *Wray 1174*, Peninsular Malaysia, Perak, Mt. Batu Putih (holotype K; isotype SING). **Synonyms:** *Syanedrys lampadaria* (Gamble) Koidzumi *l.c.* 192; *Quercus lampadaria* (Gamble) Burkill, Kew Bull. (1935) 318.

Tree up to 36 m tall, 100 cm diameter. **Bark** scaly or fissured, brown; inner bark fibrous, brownish. **Sapwood** brownish or yellowish. **Twigs** sparsely appressed tomentose, sparsely to densely large-lenticellate. **Stipules** linear, 6–15 × 1–3 mm. **Leaves** thick-coriaceous, rigid, glabrous above, *sparsely brownish appressed tomentose below*; broadly ovate, elliptic, or obovate, (13–)15–27(–38) × (5–)8–14(–23) cm, base acute to cuneate, margin revolute, apex acute to acuminate, acumen 15–25 mm long; midrib broad, strongly raised on both surfaces; *lateral veins* thick, (6–)10–15(–20) pairs, dense or lax, impressed or flat above, raised below, *disappearing near the leaf margin*, forming an angle of 45–60° with the midrib; *intercostal venation usually scalariform*, dense, *obscure above*, *prominent below*; *petiole 10–27 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 6–20 cm long; bracts ovate, *c.* 1 × 0.7 mm; bracteoles linear, 0.8–0.9 × 0.2 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1.6 × 1.3 mm; stamen filaments *c.* 2 mm long; pistillode globose, *c.* 1 mm diameter. **Androgynous inflorescences** 10–18 cm long; bracts narrowly ovate, *c.* 3 × 1.5 mm; bracteoles broadly ovate, *c.* 2.8 × 2.5 mm. **Female flowers** in clusters of 3–5 along the rachis; perianth lobes acute, *c.* 1 × 0.5 mm; staminodes 10; styles conical, straight, *c.* 1 mm long. **Cupules** in clusters of 2–5 or rarely solitary along the rachis, sessile, cup-shaped, 1–2 × 2–4 cm, densely appressed tomentose, *scaly*; wall woody, very thick, enclosing up to half of the acorn; scale-like appendages slightly distinct, set in regular lines. **Acorns** depressed ovoid to subglobose, 2–2.5 × 3–3.5 cm, *most part exserted*, glabrous, dark brown; base flat, apex rounded; scar deeply concave, 1–2 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Vernacular name. Sarawak—*salad kup* (Murut).

Distribution. Peninsular Malaysia and Borneo. In Sabah known from Ranau, Tambunan and Tenom districts. In Sarawak only known from Sg. Buong in Belaga district and Kota FR in Limbang district. Also in Kalimantan.

Ecology. In primary and secondary hill mixed dipterocarp forest to lower montane forest, at 300–1800 m altitude, on sandstone-derived soils.

34. **Lithocarpus leptogyne** (Korth.) Soepadmo

(Greek, *leptogyne* = with slender female organ; the slender young female flower and acorn)

Reinwardtia 8 (1970) 254, *l.c.* (1972) 379; Cockburn *l.c.* (1972) 223, *l.c.* (1976) 110; Anderson *l.c.* 201; Whitmore, Tantra & Sutisna *l.c.* 157; Kessler & Sidiyasa *l.c.* 141; PROSEA *l.c.* 298; Coode *et al.* (eds.) *l.c.* 126; Argent *et al.* (eds.) *l.c.* 249. **Basionym:** *Quercus leptogyne* Korth., Kruidk. (1844) 206. **Type:** *Korthals s.n.* (= *RHL Sheet No 90131137*), Borneo, Kalimantan, Mt. Sakumbang (holotype L; isotypes A, P). **Synonyms:** *Cyclobalanus leptogyne* (Korth.) Oerst. *l.c.* (1871) 376; *Q. lamponga* (*non* Miq.) Hook. *f.*, Fl. Brit. Ind. 5 (1888) 611; *Q. conocarpa* (*non* Oudem.) Merr. *l.c.* (1929) 43.

Tree up to 40 m tall, 90 cm diameter; buttresses up to 1.5 m tall. **Bark** smooth or lenticellate, greyish; inner bark granular, brownish. **Sapwood** yellowish. **Twigs** densely tomentose with stellate hairs, sparsely minute-lenticellate. **Stipules** linear, 3–6 × 1 mm. **Leaves** coriaceous, *sparsely yellowish tomentose with stellate and simple hairs on both surfaces*; elliptic, lanceolate, or elliptic-oblong, (7.5–)12–16(–19) × (2.5–)3.5–4.5(–6.5) cm, base acute, rarely rounded, margin revolute, apex acuminate, acumen 10–15(–20) mm long; midrib thin, raised on both surfaces; *lateral veins* thick, 11–14(–18) pairs, dense, impressed or flat above, raised below, *clearly joining near the leaf margin*, forming an angle 30–60° with the midrib; *intercostal venation subscalariform*, lax, *obscure above*, *prominent below*; *petiole 6–8(–10) mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 10–20 cm long; bracts ovate, *c.* 0.7 × 0.5 mm; bracteoles broadly ovate, *c.* 0.5 mm across. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 0.7

× 0.5 mm; stamen filaments 2–3 mm long; pistillode subglobose, *c.* 1 mm diameter. **Androgynous** or **mixed inflorescences** 6.5–10 cm long; bracts and bracteoles ovate, *c.* 1 × 0.5 mm. **Female flowers** solitary along the rachis; perianth lobes acute, 0.5–0.7 mm across; staminodes 12; styles conical, slightly recurved, *c.* 1 mm long. **Cupules** solitary along the rachis, with stalk *c.* 5 mm long, saucer-shaped, 0.3–0.8 × 1.3–2 cm, densely tomentose, *scaly*; wall woody, thick, densely tomentose, enclosing less than half of the acorn; scale-like appendages distinct, appressed, dense, regularly set. **Acorns** *conical*, 1.2–2 × 1.5–2 cm, *most part exserted*, densely simple-hairy, brownish or purplish; base rounded, apex acute; scar deeply concave or flat, *c.* 1.2 cm diameter; *wall woody*, *thin*, *most part free from the cupule.*

Vernacular names. Sabah—*pening-peningan* (Kedayan), *tikalod* (Dusun, Bundu Tuhan), *turug* (Sungai). Sarawak—*kalan* (Berawan).

Distribution. Peninsular Malaysia and Borneo. Very common and widespread throughout Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In hill mixed dipterocarp forest to lower montane forest, up to 1800 m altitude, on various types of soils.

35. **Lithocarpus lucidus** (Roxb.) Rehder Fig. 12.

(Latin, *lucidus* = shining; the acorn and upper leaf surface)

J. Arn. Arb. 1 (1919) 128; Soepadmo *l.c.* (1970) 254, *l.c.* (1972) 341; Cockburn *l.c.* (1972) 223, *l.c.* (1976) 113; Anderson *l.c.* 201; Corner *l.c.* 341; Whitmore, Tantra & Sutisna *l.c.* 157; Turner *l.c.* 237; PROSEA *l.c.* 298; Coode *et al.* (eds.) *l.c.* 126; Argent *et al.* (eds.) *l.c.* 249; Kochummen *l.c.* 248. **Basionym:** *Quercus lucida* Roxb., Fl. Ind. 3 (1832) 635. **Type:** *Roxburgh s.n.*, Peninsular Malaysia, Penang (holotype BR; isotype BM). **Synonyms:** *Q. cuneata* A. DC., Prod. 16, 2 (1864) 108; *Pasania lucida* (Roxb.) Gamble *l.c.* (1915) 440; *Synaedrys lucida* (Roxb.) Koidzumi *l.c.* 192; *Q. omalokos* Korth. *l.c.* 214; *Cyclobalanus omalokos* (Korth.) Oerst. *l.c.* (1867) 80; *P. omalokos* (Korth.) Schottky *l.c.* (1912) 676; *S. omalokos* (Korth.) Koidzumi *l.c.* 192; *L. omalokos* (Korth.) Rehder *l.c.* (1919) 129.

Tree up to 50 m tall, 120 cm diameter; buttresses up to 1 m tall. **Bark** smooth, brown; inner bark granular, yellowish brown. **Sapwood** yellowish to brownish. **Twigs** glabrescent, sparsely lenticellate. **Stipules** linear, 2–3 × 1 mm. **Leaves** *coriaceous, sometimes rigid*, *glabrous on both surfaces*, *shining above*; *oblanceolate*, *(4–)8–12(–16) × (2–)4–6(–8) cm*, *base cuneate*, *decurrent*, margin revolute sometimes undulate, apex rounded, obtuse, acute to abruptly cuspidate; *midrib faintly raised on both surfaces*; lateral veins thin, (10–)14–16(–20) pairs, dense, flat on both surfaces or slightly raised below, faintly joining near the leaf margin, forming an angle of 40–60° with the midrib; *intercostal venation reticulate*, *dense*, *thin but distinct on both surfaces*; *petiole 2–7 mm long*. **Inflorescences** male, female or androgynous. **Male inflorescences** 9–20 cm long; bracts and bracteoles ovate, 0.6–1 × 0.3–0.6 mm. **Male flowers** in clusters of 3–4 along the rachis; perianth lobes obtuse, *c.* 1 × 0.8 mm; stamen filaments *c.* 2 mm long; pistillode globose, *c.* 0.8 mm diameter. **Female** or **androgynous inflorescences** 10–20 cm long; bracts narrowly ovate, *c.* 1.4 × 0.3–0.6 mm; bracteoles broadly ovate, *c.* 1 × 0.9 mm. **Female flowers** solitary or in clusters of 3 along the rachis; perianth lobes acute, *c.* 1 × 0.7 mm; staminodes

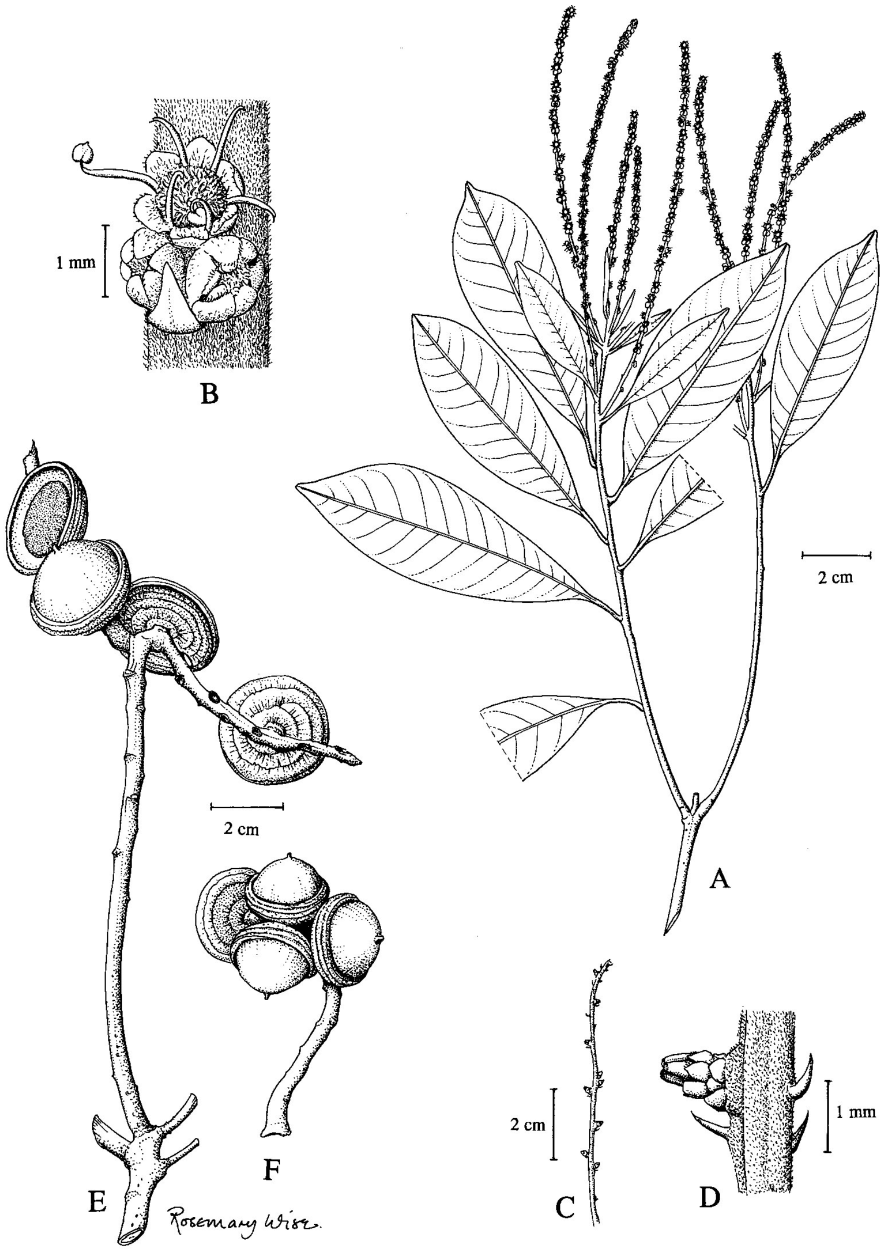

Fig. 12. *Lithocarpus lucidus*. A, leafy flowering (male) twig; B, cluster of 3 male flowers; C, part of female inflorescence; D, female flower; E–F, infructescences. (A–B from *SAN A 388*, C–D from *SAN 21740*, E from *SAN 92172*, F from *Kostermans 9224*.)

10; styles conical, straight, *c.* 1.2 mm long. **Cupules** solitary but arranged closely together or sometimes in clusters of 3 along the rachis, sessile or with stalk *c.* 5 mm long, *cup- or saucer-shaped*, 0.5–1(–1.5) × 2–3.5 cm, glabrescent, *lamellate*; wall woody, thick, glabrescent, enclosing half or less of the acorn; lamellae dense and distinct, edge minutely denticulate or undulate, set in 8–11 regular lines. **Acorns** depressed ovoid, 1.5–2.5 × 2–3.5 cm, *most part exserted*, *glabrous and shining*, brown purplish; base flat, apex rounded or acute; scar deeply concave 1.5–2 cm diameter; *wall woody*, *thin*, *most part free from the cupule.*

Vernacular names. Sabah—*sarusup tembaung* (Dusun, Kimanis). Sarawak—*saled arong* (Kelabit).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. Common and widespread throughout Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp forest to lower montane forest, up to 1400 m altitude, on clay, sandy-clay and sandstone-derived soils.

Use. The wood is locally used for house construction.

36. **Lithocarpus luteus** Soepadmo

(Latin, *luteus* = golden yellow; the indumentum of the acorn)

Reinwardtia 8 (1970) 255, *l.c.* (1972) 345; Cockburn *l.c.* (1976) 101; Anderson *l.c.* 201; Whitmore, Tantra & Sutisna *l.c.* 158; PROSEA *l.c.* 298; Argent *et al.* (eds.) *l.c.* 249. **Type:** *Clemens 32817,* Borneo, Sabah, Mt. Kinabalu, Mt. Nuntok ridges (holotype L; isotypes A, BM, K, NY, UC).

Tree up to 40 m tall, 100 cm diameter; buttresses *c.* 2 m tall. **Bark** deeply fissured to scaly, lenticellate, reddish brown; inner bark fibrous, reddish or brownish. **Sapwood** greyish. **Twigs** glabrescent, densely warty lenticellate. **Stipules** linear, 3–6 × 1 mm. **Leaves** thick-coriaceous, *glabrous above*, *sparsely appressed tomentose below*; elliptic, *(7–)9–13(–27) × (2.5–)4–6.5(–12) cm*, base acute to cuneate, margin revolute, apex acute to acuminate, acumen 10–15 mm long; midrib flat above, broad and strongly raised below; lateral veins thin, 9–12(–14) pairs, dense, flat above, raised below, disappearing near the leaf margin, forming an angle of *c.* 45° with the midrib; *intercostal venation scalariform*, *very dense*, *obscure above*, *thin but distinct below*; *petiole 8–15(–20) mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 9–15 cm long; bracts ovate, 3 × 1.8–2 mm; bracteoles elliptic, *c.* 1 × 0.3 mm. **Male flowers** solitary or in clusters of 3 along the rachis; perianth lobes obtuse, 1–1.2 × 0.6 mm; stamen filaments 2–3 mm long; pistillode subglobose, 1–1.2 mm diameter. **Androgynous inflorescences** 5–13 cm long; bracts and bracteoles narrowly ovate, 1–2 × 0.3–1 mm. **Female flowers** solitary or in clusters of 2–3 along the rachis; perianth lobes obtuse, 0.8–1 × 0.6–1 mm; staminodes 10–12; styles conical, straight, *c.* 1 mm long. **Cupules** in clusters of 2–3 or solitary along the rachis, sessile or with stalk *c.* 5 mm long, cup-shaped, 1–1.5 × 2–3 cm, tomentose, *lamellate*; wall woody, thick, hairy, enclosing up to half of the acorn; lamellae obscure or slightly distinct, edge denticulate, set in 8–10 regular lines. **Acorns** ovoid to subglobose, 1–2 × 2–2.5 cm, *most part exserted*, *densely covered with golden yellow hairs*, brown; base flat, apex acute; *scar flat or shallowly concave*, *c.* 2 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Endemic to Borneo. In Sabah, very common in Ranau district, and also recorded for Tambunan, Tenom and Sandakan districts. In Sarawak, known mainly in Kapit, Miri (G. Mulu and Lambir NP) and Lawas districts. Also in Kalimantan.

Ecology. In primary hill mixed dipterocarp forest to lower montane forest, at 500–1800 m altitude.

37. **Lithocarpus mariae** Soepadmo

(Mrs. M.J. van Steenis-Kruseman, 1904–1999, the highly respected bibliographer and biographer of Malesian botany)

Reinwardtia 8 (1970) 258, *l.c.* (1972) 338; Cockburn *l.c.* (1976) 103; Anderson *l.c.* 201; Whitmore, Tantra & Sutisna *l.c.* 158; Argent *et al.* (eds.) *l.c.* 249. **Type:** *Anderson et al. S. 15404*, Borneo, Sarawak, Lundu district, Mt. Lundu (holotype L; isotypes A, BK, K, M, S, SAR, SING).

Tree up to 35 m tall, 60 cm diameter; buttresses *c.* 0.7 m tall. **Bark** smooth, lenticellate, greyish; inner bark granular, red-brown. **Sapwood** yellowish. **Twigs** glabrescent, smooth or sparsely lenticellate. **Leaves** thin-coriaceous, glabrous above, *sparsely appressed yellowish tomentose below*; ovate or elliptic, (8–)10–12(–13) × 4–5(–9) cm, *base rounded*, *symmetrical*, *margin revolute*, *not undulate*, apex acute to acuminate, acumen 10–15 mm long; midrib flat above, raised below; *lateral veins thin*, *(9–)10–12 pairs*, *lax*, flat or impressed above, raised below, *faintly joining or disappearing near the leaf margin*, forming an angle of 45–60° with the midrib; *intercostal venation* scalariform, *dense*, obscure on both surfaces or thinly prominent below; *petiole 15–25 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 10–15 cm long; bracts ovate, *c.* 0.5 × 0.3 mm; bracteoles linear, *c.* 0.5 × 0.1 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 0.5 mm across; stamen filaments 2.5–3 mm long; pistillode globose, *c.* 0.5 mm diameter. **Androgynous inflorescences** 8–10 cm long; bracts triangular, *c.* 0.7 × 0.5 mm; bracteoles linear, *c.* 0.7 × 0.2 mm. **Female flowers** solitary along the rachis; perianth lobes rounded, *c.* 0.5 mm across; staminodes 12; styles triangular, straight, *c.* 1 mm long. **Cupules** solitary along the rachis, with stalk 10–20 mm long, ovoid, 2–4 × 2.5–3 cm, densely tomentose, *smooth*, *often with longitidunal streaks*; wall bony, thin, *completely enclosing the acorn*. **Acorns** *ovoid*, 2–3.5 × 2–2.5 cm, *free part densely tomentose with simple hairs*, dark brown; base rounded, apex acute; *scar deeply concave*, *c. 2 cm diameter*; *wall woody*, *thin*, *most part free from the cupule.*

Distribution. Endemic to Borneo; uncommon. In Sabah, documented from Tawau, Beaufort, Kota Belud, and Kudat districts. In Sarawak, known from Kuching, Kapit and Limbang districts. Also in Kalimantan.

Ecology. In primary hill mixed dipterocarp forest, on flat lands and hilly sides, up to 800 m altitude.

38. **Lithocarpus meijeri** Soepadmo

(W. Meijer, 1923–; 1959–1968 forest botanist at Sandakan, Sabah, and later Professor of Biology, University of Kentucky, Lexington, U.S.A.)

Reinwardtia 8 (1970) 260, *l.c.* (1972) 352; Cockburn *l.c.* (1976) 113; Anderson *l.c.* 202; Whitmore, Tantra & Sutisna *l.c.* 158; PROSEA *l.c.* 299; Coode *et al.* (eds.) *l.c.* 126; Argent *et al.* (eds.) *l.c.* 251. **Type:** *Meijer SAN 39608*, Borneo, Sandakan district, Sepilok FR (holotype L; isotypes K, SAN, SING).

Tree up to 40 m tall, 100 cm diameter. **Bark** smooth or fissured or scaly, greyish to reddish brown; inner bark brownish. **Sapwood** yellowish brown. **Twigs** sparsely tomentose with simple hairs, sparsely to densely lenticellate. **Stipules** linear, 3–4 mm long. **Leaves** coriaceous, *glabrous above*, *sparsely yellowish appressed tomentose below*; elliptic, obovate, or broadly elliptic, *(11–)13–16(–20) × (4–)5–7(–8.5) cm*, *base cuneate*, *decurrent*, margin revolute, apex acute to acuminate, acumen 5–10 mm long, rarely rounded; *midrib flat above*, *raised below*; lateral veins thin, (9–)11–13 pairs, dense, flat above, raised below, disappearing near the leaf margin, forming an angle of *c.* 45° with the midrib; *intercostal venation scalariform*, *dense*, *prominent on both surfaces*; *petiole 10–15 mm long*. **Inflorescences** male, female, androgynous or mixed. **Male inflorescences** 7–14 cm long; bracts linear, *c.* 1 × 0.2 mm; bracteoles broadly ovate, *c.* 0.5 × 0.4 mm. **Male flowers** solitary or in clusters of 2–3 along the rachis; perianth lobes obtuse, *c.* 1.3 × 0.6 mm; stamen filaments *c.* 2.5 mm long; pistillode subglobose, 0.8–1 mm diameter. **Female, androgynous** or **mixed inflorescences** 8–15 cm long; bracts and bracteoles narrowly ovate, 0.8–1.2 × 0.5 mm. **Female flowers** solitary or in clusters of 2–3 along the rachis; perianth lobes acute, *c.* 0.8 × 0.5 mm; staminodes 12; styles conical, straight, *c.* 1.5 mm long. **Cupules** solitary or in clusters of 2–3 along the rachis, *sessile*, cup-shaped, 1–1.8 × 2–2.5 cm, densely appressed tomentose, *lamellate*; wall woody, thick, enclosing less than half of the acorn; lamellae distinct, edge entire or undulate, sometimes obscure, set in 6–7 regular lines. **Acorns** depressed ovoid, 0.5–2 × 1.7–3 cm, *most part exserted*, *densely silvery grey tomentose with simple hairs*, brown; base flat, apex acute; *scar deeply concave*, *1.5–2 cm diameter*; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Peninsular Malaysia and Borneo. Common throughout Sabah. In Sarawak, known from Kapit, Miri and Kuching districts. Also in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp forest, including *kerangas* forest, usually on steep hilly sides, up to 1100 m altitude.

39. **Lithocarpus melataiensis** S. Julia & Soepadmo

(of Bt. Melatai, Sarawak)

Gard. Bull. Sing. 50 (1998) 137. **Type:** *Yii S. 48455*, Borneo, Sarawak, Kapit district, Bt. Melatai (holotype SAR; isotypes BKF, K, KEP, KLU, L).

Tree up to 30 m tall, 70 cm in diameter. **Twigs** sparsely tomentose, smooth or fissured. **Stipules** linear, *c.* 10 × 1 mm. **Leaves** *thin-coriaceous, sparsely appressed brownish tomentose with simple hairs on both surfaces*; *narrowly elliptic*, *9–13.5 × 2–3 cm*, base acute or cuneate, *margin revolute*, *apex caudate or long-acuminate*, *acumen 15–22 mm long*; midrib slightly raised on both surfaces; lateral veins thin, (8–) 9–12 pairs, dense, flat above, raised below, faintly joining near the leaf margin, forming an angle of 40–50° with the midrib; *intercostal venation subscalariform*, lax, *obscure on both surfaces* *or thinly prominent below*; *petiole 6–12 mm long*. **Inflorescences** male and female. **Male inflorescences** 5–11 cm long; bracts linear, triangular, 1–1.3 × 0.3 mm; bracteoles ovate, 0.4–0.6 × 0.3–0.5 mm. **Male flowers** solitary along the rachis; perianth lobes rounded, 1–1.2 × 0.5–1 mm; stamen filaments 2–2.5 mm long; pistillode globose, *c*. 1 mm in diameter. **Female inflorescences** 9.5–12.5 cm long; bracts linear, triangular, *c*. 1.2 × 0.3–0.5 mm; bracteoles obtuse, 0.2–0.3 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, 0.4–0.6 × 0.2–0.3 mm; staminodes 10; styles conical, straight, *c*. 1 mm long. **Cupules** solitary along the rachis, sessile, deeply saucer-shaped, 0.4–0.7 × 1.2–1.7 cm, densely tomentose with stellate and simple hairs, *lamellate*; wall bony, thin, enclosing less than half of the acorn; lamellae distinct, edge minutely denticulate, set in 6–8 regular lines. **Acorns** conical, 1.7–2 × 1–1.5 cm, *most part exserted*, densely simple-hairy, brown; base flat, apex acute; scar concave, 0.7–1 cm in diameter; *wall bony*, *thin*, *most part free from the cupule*.

Distribution. Endemic to Sarawak. So far only known from Bt. Melatai and Ulu Batang Baleh in Kapit district.

Ecology. In hill mixed dipterocarp forest, at 300–900 m altitude.

40. **Lithocarpus muluensis** S. Julia & Soepadmo

(of G. Mulu, Sarawak)

Gard. Bull. Sing. 50 (1998) 139. **Type:** *Ilias S. 15082*, Borneo, Sarawak, G. Mulu NP (holotype SAR).

Tree up to 30 m tall, 75 cm in diameter. **Bark** flaky. **Twigs** glabrescent, fissured or sparsely lenticellate. **Leaves** *thick-coriaceous*, *rigid*, glabrous above, *sparsely appressed yellowish tomentose below*; elliptic to broadly elliptic, *(8–)11–17 × (4.5–)5.5–8.5(–9) cm*, base acute, margin strongly revolute, *apex acute to acuminate*, acumen (5–)13–23 mm long; midrib raised on both surfaces, stronger above; lateral veins thin, 9–15 pairs, dense or lax, slightly raised on both surfaces, faintly joining near the leaf margin, forming an angle of 40–50° with the midrib; *intercostal venation subscalariform*, lax, *obscure on both surfaces*; *petiole (8–)10–13(–15) mm long*. **Inflorescences** and **flowers** unknown. **Cupules** in clusters of 2 along the rachis when young, later solitary along the rachis, sessile, saucer-shaped, 1.8–2.4 × 2–2.5 cm, sparsely stellate-tomentose, *scaly*; wall woody, thick, enclosing less than half of the acorn; *scale-like appendages distinct*, *broad and rigid*, set irregularly. **Acorns** depressed subglobose, 1.8–2.4 × 2–2.5 cm, *most part exserted*, *glabrous and shining*, dark brown; base flat, apex rounded; *scar deeply concave*, *1.5–1.7 cm in diameter*; *wall woody*, *thick*, *most part free from the cupule*.

Distribution. Endemic to Sarawak. So far only known from G. Mulu NP in Miri district.

Ecology. In primary hill mixed dipterocarp forest to lower montane forest, up to 1500 m altitude.

41. **Lithocarpus nieuwenhuisii** (Seemen) A. Camus

(A.W. Nieuwenhuis, 1864–1900, surgeon and amateur botanist)

Bull. Soc. Bot. France 92 (1945) 255; Soepadmo *l.c.* (1970) 262, *l.c.* (1972) 379; Cockburn *l.c.* (1976) 114; Anderson *l.c.* 202; Whitmore, Tantra & Sutisna *l.c.* 158; PROSEA *l.c.* 299; Coode *et al.* (eds.) *l.c.* 126; Argent *et al.* (eds.) *l.c.* 251. **Basionym:** *Quercus nieuwenhuisii* Seemen, Bull. Dépt. Agr. Ind. Néerl. 1 (1906) 6. **Type:** *Jaheri 1546*, Borneo, Kalimantan, Sg. Salut (holotype BO). **Synonyms:** *Synaedrys nieuwenhuisii* (Seemen) Koidzumi *l.c.* 197; *Q. clementis* Merr. *l.c.* (1908) 321; *Pasania clementis* (Merr.) Schottky *l.c.* (1913) 358; *S. "clementi"* (Merr.) Koidzumi *l.c.* 194; *L. clementis* (Merr.) A. Camus *l.c.* (1932) 39; *P. ochracea* Schottky *l.c.* (1913) 357; *Q. ochracea* (Schottky) Merr. *l.c.* (1921) 214; *L. ochracea* (Schottky) A. Camus *l.c.* (1932) 41; *Q. borneensis* Merr. *l.c.* (1922) 516; *L. borneensis* (Merr.) Rehder *l.c.* (1929) 132; *L. crateriformis* Merr. *ex* A. Camus *l.c.* (1949) 97.

Tree up to 30 m tall, 70 cm diameter; buttresses and stilt-roots sometimes present. **Bark** scaly or lenticellate, greyish brown; inner bark fibrous, yellowish or brownish. **Sapwood** greyish or yellowish. **Twigs** densely tomentose with stellate and simple hairs, sparsely lenticellate. **Stipules** ovate, 5–6 × 2 mm. **Leaves** thin-coriaceous, *sparsely stellate-hairy above especially on the midrib and veins*, *densely pubescent with stellate and simple hairs below*; *oblanceolate*, *broadly elliptic to oblong*, (6–)11–20.5(–28) × (2–)3.5–6.5(–8.5) cm, base attenuate, acute, or obtuse, occasionaly asymmetrical, margin revolute, apex acute with emarginate tip to acuminate with acumen 10–20 mm long; midrib raised on both surfaces, stronger below; *lateral veins* thick, (7–)10–12(–15) pairs, lax, impressed or flat above, strongly raised below, *clearly joining near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation subscalariform*, *lax*, *impressed above*, *prominent below*; *petiole (3–)5–8(–15) mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 10–20 cm long; bracts narrowly ovate, *c.* 1.3 × 0.5 mm; bracteoles ovate, *c.* 0.6 × 0.3 mm. **Male flowers** solitary along the rachis; perianth lobes acute, *c.* 1 × 0.8 mm; stamen filaments 1.5–2 mm long; pistillode subglobose, *c.* 0.5 mm diameter. **Androgynous** or **mixed inflorescences** 10–25 cm long; bracts narrowly ovate, *c.* 1 × 0.4 mm; bracteoles broadly ovate, *c.* 0.9 × 0.7 mm. **Female flowers** solitary along the rachis; perianth lobes acute, 0.5–1 mm across; staminodes 12; styles cylindrical, recurved, *c.* 2 mm long. **Cupules** *solitary and distantly spaced along the rachis*, subsessile, cup-shaped, 1.5–2.5 × 2–3 cm, densely appressed tomentose with stellate hairs, *scaly*; wall woody, thin, enclosing up to half of the acorn; scale-like appendages distinct, appressed, imbricate, sparsely and irregularly arranged. **Acorns** ovoid, subglobose to cylindrical, (1.5–)2–4.5 × 1.5–2.5 cm, *most part exserted*, *glabrous except for the sparsely simple-hairy apex*, dark purple; base flat, apex acute; scar deeply concave or flat, 0.5–1 cm diameter; *wall woody*, *thin*, *most part free from the cupule.*

Vernacular name. Sarawak—*empili batu* (Iban).

Distribution. Peninsular Malaysia, Borneo and the Philippines. Very common and widely distributed in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp, swamp, *kerangas*, riparian to lower montane forests, up to 1500 m altitude, mainly on sandy clay soils.

42. **Lithocarpus nodosus** Soepadmo

(Latin, *nodosus* = knobby; the knobby twigs)

Reinwardtia 8 (1970) 262, *l.c.* (1972) 357; Cockburn *l.c.* (1976) 105; Anderson *l.c.* 202; Whitmore, Tantra & Sutisna *l.c.* 158. **Type:** *Meijer SAN 21980*, Borneo, Sabah, Mt. Kinabalu, Kundasang (holotype L; isotypes K, SAN).

Tree up to 20 m tall, 30 cm diameter. **Bark** smooth, brownish; inner bark granular, brownish. **Sapwood** whitish. **Twigs** glabrous, *with thickened nodes*, sparsely large-lenticellate. **Stipules** narrowly ovate to linear, 1–2 × 0.5 mm. **Leaves** *thin-coriaceous to coriaceous*, *not rigid*, glabrous above, *sparsely appressed yellowish tomentose below*; elliptic, *6–10(–12) × (3–) 4–5(–6) cm*, base acute, *margin strongly revolute*, *apex acute to acuminate*, *acumen 10–15 mm long*; midrib broad, flat above, raised below; *lateral veins* thin, (6–)8–10 pairs, lax, flat or slightly impressed above, raised below, *disappearing near the leaf margin*, forming an angle of 30–50° with the midrib; *intercostal venation subscalariform*, dense, *obscure on both surfaces*; *petiole 8–13 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 3–10 cm long; bracts and bracteoles linear, 0.9–1 × 0.2–0.3 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 1 × 0.7 mm; stamen filaments 1–2 mm long; pistillode subglobose, 0.5–0.7 mm diameter. **Androgynous inflorescences** 6.5–9 cm long; bracts linear, *c.* 1.2 × 0.4 mm; bracteoles ovate, *c.* 1 × 0.6 mm. **Female flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1 mm across; staminodes 10–12; styles conical, straight, 1.5–2 mm long. **Cupules** solitary along the rachis, sessile, *cup-shaped*, *0.6–1 × 1.8–2.5 cm*, densely appressed tomentose with simple hairs, *lamellate*; wall woody, thin, enclosing less than half of the acorn; lamellae distinct, edge minutely denticulate, set in 4–5 regular lines. **Acorns** ovoid to subglobose, 1–2 (–2.5) × 1.7–2.3 cm, *most part exserted*, glabrous, dark brown; base rounded, apex acute; scar deeply concave, *c.* 1 cm diameter; *wall woody*, *thin*, *most part free from the cupule.*

Distribution. Endemic to Borneo. In Sabah, common in Ranau district especially in Kinabalu Park, and also recorded for Mt. Trus Madi in Tambunan district. In Sarawak, known only from Miri and Sri Aman districts. Also in Kalimantan.

Ecology. In primary hill mixed dipterocarp forest to montane forest, including limestone habitat, at 300–2400 m altitude, on different types of soils including ultrabasic.

43. **Lithocarpus oblancifolius** S. Julia & Soepadmo.

(Latin, *oblancifolius* = with reversed lance-shaped leaves)

Gard. Bull. Sing. 50 (1998) 141. **Type:** *Leopold SAN 133942*, Borneo, Sabah, Tawau district, Tawau Hill Park (holotype SAN).

Tree up to 24 m tall, 45 cm in diameter. **Bark** lenticellate or smooth, brown or greyish; inner bark greyish to yellowish. **Sapwood** whitish to yellowish. **Twigs** sparsely tomentose, late-subglabrescent, smooth or sparsely large-lenticellate. **Stipules** narrowly ovate, *c.* 2 × 1 mm. **Leaves** *thin-coriaceous*, *not rigid*, *glabrous above, sparsely appressed greyish tomentose below*; *oblanceolate*, *(6–)8–13.5 × (2.5–)3–4.5 cm*, *base cuneate*, margin revolute, apex rounded or acute; *midrib faintly raised on both surfaces*, stronger below; lateral veins thin, 8–13 pairs, lax, flat or impressed above, raised below, joining near the leaf margin, forming an angle of 30–50° with the midrib; *intercostal venation reticulate or subscalariform*, *dense*, *obscure above*, *prominent below*; *petiole 3–5 mm long*. **Inflorescences** male, female, androgynous or mixed. **Male inflorescences** 3–11 cm long; bracts narrowly ovate, *c.* 1 × 0.3 mm; bracteoles linear, *c.* 5 × 0.1 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, 0.8–1 × 0.6–0.8 mm; stamen filaments *c*. 2 mm long; pistillode globose, 0.7–0.8 mm diameter. **Female, androgynous** or **mixed inflorescences** 4–12 cm long; bracts linear, 1–1.2 × 0.2–0.4 mm; bracteoles narrowly ovate, *c*. 0.5 × 0.2 mm. **Female flowers** solitary along the rachis; perianth lobes acute or obtuse, 0.5–0.9 × 0.5–0.7 mm; staminodes 12; styles conical, recurved, 1–1.2 mm long. **Cupules** solitary along the rachis, sessile, *saucer-shaped*, 1–1.2 × 1.6–2 cm, densely appressed tomentose with stellate and simple hairs, *lamellate*; wall woody, thin, enclosing less than half of the acorn; lamellae distinct, edge entire, set in 6–8 regular lines. **Acorns** ovoid to conical, 1.6–1.8 × 1.6–2 cm, *most part exserted*, *glabrous*, brown; base flat, apex acute; scar concave, *c*. 1.5 cm in diameter; *wall bony*, *thick*, *most part free from the cupule.*

Distribution. Endemic to Sabah. Known from Tawau Hill Park in Tawau district and Sg. Piso in Labuk Sugut district.

Ecology. In lowland mixed dipterocarp forest, near riverbanks, in rather open area, up to 100 m altitude.

44. **Lithocarpus papillifer** Soepadmo

(Latin, *papillia* = soft superficial protuberances, *-fer* = bearing; the papillate leaves and twigs)

Reinwardtia 8 (1970) 265, *l.c.* (1972) 370; Cockburn *l.c.* (1976) 105; Anderson *l.c.* 202; Whitmore, Tantra & Sutisna *l.c.* 158; Coode *et al.* (eds.) *l.c.* 126. **Type:** *Clemens 32493*, Borneo, Sabah, Labuk Sugut district, Kolombuon R. (holotype L; isotypes A, BM, BO, K, NY, UC).

Tree up to 25 m tall, 40 cm diameter. **Bark** smooth or fissured or lenticellate, greyish brown; inner bark fibrous, reddish. **Sapwood** yellowish. **Twigs** *sparsely reddish brown papillate*, densely minute-lenticellate. **Stipules** ovate, 1–2 × 1 mm. **Leaves** thick-coriaceous, rigid, *covered with reddish brown papillae on both surfaces*, *denser below*; elliptic or ovate, (4–)6–10(–12) × (2–)3–4(–5.5) cm, base acute, *margin strongly revolute*, *apex obtuse*, *rounded*, *or emarginate*; midrib slightly raised above, raised below; lateral veins thin, 5–7(–8) pairs, dense or lax, impressed or flat above, strongly raised below, faintly joining or disappearing near the leaf margin, forming an angle of 45–60° with the midrib; *intercostal venation scalariform*, dense, *obscure on both surfaces or slightly prominent below*; *petiole 5–10 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 3–5 cm long; bracts and bracteoles ovate, 0.9–1.2 × 0.6–0.7 mm. **Male flowers** in clusters of 2–4 along the rachis; perianth lobes obtuse, *c*. 0.8 × 0.3 mm; stamen filaments 1–2 mm long; pistillode subglobose, 0.8–1 mm diameter. **Androgynous inflorescences** 4–8 cm long; bracts ovate, 0.9–1 × 0.6 mm; bracteoles broadly ovate, *c*. 0.5 × 0.4 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c*. 0.4 × 0.3 mm; staminodes 10; styles conical, straight, 0.9–1 mm long. **Cupules** solitary along the rachis, sessile, saucer-shaped, 0.3–0.9 × 1.5–2.3 cm, densely appressed tomentose with stellate hairs mixed with a few reddish brown papillae, *scaly*; wall bony, thin, enclosing less than half of the acorn; scale-like appendages distinct, imbricate, set regularly. **Acorns** depressed ovoid, 1.5–1.8 × 1.2–2.3 cm, *most part exserted*, glabrous, chocolate brown; base flat, apex acute; scar deeply concave, 0.8–1 cm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Vernacular name. Sarawak—*salad padeh* (Kelabit).

Distribution. Peninsular Malaysia and Borneo. In Sabah, known only from Kolombuon R. in Labuk Sugut district, Sosopodon in Ranau district, and Crocker Range in Tambunan district. In Sarawak, uncommon, and documented from Miri, Kapit, Limbang and Sri Aman districts. Also in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp forest to montane forest, rarely in limestone habitat, at 800–2300 m altitude.

45. **Lithocarpus porcatus** Soepadmo

(Latin, *porcatus* = ridged; the cupule)

Reinwardtia 8 (1970) 268, *l.c.* (1972) 327; Cockburn *l.c.* (1976) 100; Anderson *l.c.* 202; Whitmore, Tantra & Sutisna *l.c.* 158. **Type:** *Carr SFN 26677*, Borneo, Sabah, Mt. Kinabalu, Menetudok Gorge (holotype SING).

Tree up to 30 m tall, 50 cm diameter. **Bark** smooth or flaky, sometimes lenticellate, greyish green; inner bark brown. **Sapwood** yellowish. **Twigs** densely tomentose, late-glabrescent, smooth. **Stipules** linear, *c.* 9 × 2 mm. **Leaves** *coriaceous*, *not rigid*, *glabrous above*, *densely greyish tomentose with appressed hairs below*; broadly ovate to elliptic, *(16–)18–20(–25) × (6.5–)9–10(–13) cm*, base rounded to acute, margin revolute, *apex obtuse to short-acuminate*, *acumen up to 5 mm long*; midrib raised on both surfaces, stronger below, glabrous; *lateral veins* thin, 10–13(–16) pairs, *lax*, flat above, strongly raised below, disappearing towards the leaf margin, forming an angle of 45–60º with the midrib; *intercostal venation scalariform*, dense, obscure on both surfaces or slightly prominent below; *petiole 5–15 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 15–20 cm long; bracts and bracteoles ovate, *c.* 1 × 0.5 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1.5 × 1 mm; stamen filaments *c.* 5 mm long; pistillode subglobose, *c.* 2 mm diameter. **Androgynous inflorescences** 8–11.5 cm long; bracts narrowly ovate, *c.* 1.8 × 0.6 mm; bracteoles broadly ovate, *c.* 0.8 × 0.6 mm. **Female flowers** solitary or in clusters of 2–3 along the rachis; perianth lobes acute, *c.* 1 × 0.9 mm; staminodes 10; styles conical, straight, 1–1.2 mm long. **Cupules** in clusters of 2–3 when young, later solitary along the rachis, with stalk 5–10 mm long, *depressed globose*, *2–3.5 × 2.5–4 cm*, densely tomentose, *lamellate and ridged*; wall woody, thick, densely hairy, *enclosing the acorn completely*; lamellae distinct, edge entire or undulate, sometimes folded inwardly, set in 5–8 lines. **Acorns** depressed subglobose, 1–2 × 1.5–2 cm, free apical part sparsely tomentose, brown; base rounded, apex flat, umbonate; *wall woody*, *thick*, *most part adnate to the cupule.*

Vernacular name. Sarawak—*tekalet kapuong* (Punan).

Distribution. Endemic to Borneo. In Sabah, widespread in Tambunan, Kota Belud, Keningau, Sipitang, Tenom, and Ranau districts. In Sarawak, known only from Bt. Batu Tiban in Kapit district, Long Amok in Limbang district, and in Kuching district. Also in Kalimantan.

Ecology. In primary hill mixed dipterocarp forest, at 900–1000 m altitude.

46. **Lithocarpus pseudokunstleri** A. Camus

(resembling *Lithocarpus kunstleri*)

Bull. Soc. Bot. France 92 (1945) 10; Soepadmo *l.c.* (1970) 268, *l.c.* (1972) 372; Cockburn *l.c.* (1976) 100; Anderson *l.c.* 202; Whitmore, Tantra & Sutisna *l.c.* 158; PROSEA *l.c.* 300; Coode *et al.* (eds.) *l.c.* 126. **Type:** *Beccari PB 3328*, Borneo, Sarawak, Marop (holotype FI; isotype K).

Tree up to 25 m tall, 45 cm diameter; buttresses 0.5–1 m tall. **Bark** scaly or lenticellate or smooth, greyish brown; inner bark granular, brownish. **Sapwood** yellowish. **Twigs** sparsely tomentose, densely to sparsely minute- or large-lenticellate, rarely fissured. **Stipules** narrowly ovate, *c.* 2 × 1 mm. **Leaves** thin-coriaceous, *glabrous on both surfaces*; elliptic to oblanceolate, (8–)9.5–15(–20) × (2.5–)4–5.5(–8.5) cm, *base attenuate*, margin revolute, apex acute to acuminate, acumen *c.* 10 mm long; midrib slightly raised above, strongly raised below; *lateral veins* thin, 6–8(–10) pairs, lax, flat or impressed above, raised below, *clearly or faintly joining near the leaf margin*, forming an angle of 45–60° with the midrib; *intercostal venation subscalariform or reticulate*, dense, *obscure above*, *prominent* or rarely obscure *below*; *petiole 3–6 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 11–15 cm long; bracts and bracteoles ovate, 0.8–1 × 0.4–0.5 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 1.3 × 0.8 mm; stamen filaments *c.* 2.5 mm long; pistillode subglobose, *c.* 1 mm diameter. **Androgynous inflorescences** 5–10 cm long; bracts and bracteoles ovate to triangular, 1–1.2 × 0.8–1 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1.2 × 1 mm; staminodes 10; styles conical, recurved, *c.* 1.5 mm long. **Cupules** solitary along the rachis, sessile, deeply cup-shaped, 1–1.8 × 1.5–2 cm, densely appressed tomentose with stellate hairs, *scaly*; wall woody, thin, enclosing less than half of the acorn; scale-like appendages slightly distinct, appressed, imbricate, irregularly set. **Acorns** *cylindrical*, *2.5–3.7 × 1.2–1.5 cm*, *most part exserted*, *sparsely simple and long hairy especially at the base and apex*, brownish; base flat, apex acute; scar flat or shallowly concave, 0.7–1 cm diameter; *wall woody*, *thin*, *most part free from the cupule.*

Vernacular name. Sarawak—*empenit johari* (Malay).

Distribution. Peninsular Malaysia and Borneo. In Sabah, documented from Sipitang, Beaufort, Tawau, Tenom, and Kinabatangan districts. In Sarawak, common in Miri, Kapit, Sibu, Sri Aman, and Kuching districts. Also in Kalimantan.

Ecology. In primary hill mixed dipterocarp forest to lower montane forest, up to 1300 m altitude, on sandy clay and sandy loam soils.

47. **Lithocarpus pulcher** (King) Markgr.

(Latin, *pulcher* = beautiful or excellent; the cupule)

Bot. Jahrb. 59 (1924) 67; Soepadmo *l.c.* (1970) 269, *l.c.* (1972) 333; Cockburn *l.c.* (1976) 103; Anderson *l.c.* 202; Whitmore, Tantra & Sutisna *l.c.* 159; PROSEA *l.c.* 300; Coode *et al.* (eds.) *l.c.* 127; Argent *et al.* (eds.) *l.c.* 251. **Basionym:** *Quercus pulchra* King *l.c.* (1889) 85. **Lectotype** (Soepadmo, 1970)**:** *Beccari PB 3123*, Borneo, Sarawak (hololectotype FI; isolectotypes K, L, NY, P). **Synonym:** *Synaedrys pulchra* (King) Koidzumi *l.c.* 189.

Tree up to 36 m tall, 80 cm diameter; buttresses 1.5–2.5 m tall. **Bark** irregulary fissured or scaly, chocolate-brown; inner bark fibrous, greyish. **Sapwood** yellowish or brownish. **Twigs** stellate-hairy, late-subglabrescent, smooth or sparsely lenticellate. **Stipules** narrowly ovate, 7–9 × 2–3 mm. **Leaves** *thick-coriaceous*, rigid, subglabrous above, densely appressed brownish tomentose with stellate hairs below; broadly elliptic to oblong, (10–)15–20 (–30) × (4–)6–8(–12.5) cm, *base acute to cuneate*, margin revolute, apex acute to acuminate, acumen 5–10 mm long; midrib flat or slightly raised above, strongly raised below; *lateral veins* (12–)15–18(–22) pairs, *dense*, flat or impressed above, strongly raised below, disappearing near the leaf margin, forming an angle of 50–70° with the midrib; *intercostal venation scalariform*, *dense*, obscure above, *thin but clearly visible below*; *petiole 10–20 mm long*. **Inflorescences** male or female. **Male inflorescences** 8–15 cm long; bracts and bracteoles ovate, *c.* 1.5 × 0.5 mm. **Male flowers** solitary along the rachis; perianth lobes acute, *c.* 1.5 × 0.5 mm; stamen filaments *c.* 1.5 mm long; pistillode globose, *c.* 2 mm diameter. **Female inflorescences** *c.* 10 cm long; bracts broadly ovate, *c.* 2 × 1.5 mm; bracteoles subrounded to broadly ovate, *c.* 1.5 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, 1–2 × 0.5 mm; staminodes 12; styles conical, straight, *c.* 1.5 mm long. **Cupules** solitary along the rachis, *sessile*, *obconical*, 2.5–4 × 3–6 cm, tomentose, *tuberculate*; wall woody, thick, hairy, *enclosing most part of the acorn except for an apical opening c. 1.5–4 cm diameter*; tubercles distinct, sturdy, irregularly and densely set at the upper part of the cupule and becoming sparse towards the base. **Acorns** obconical, 2–3 × 4–5 cm, free apical part sparsely tomentose, brown; base rounded, apex flat or convex; scar deeply convex; *wall woody*, *thick*, *most part adnate to the cupule.*

Vernacular names. Sarawak—*keraki* (Iban), *salad urong* (Kelabit).

Distribution. Endemic to Borneo. Widely distributed in Sabah. In Sarawak, very common in Kuching district but uncommon in Kapit and Miri districts. Also in Brunei and Kalimantan.

Ecology. In primary and secondary mixed dipterocarp, *kerangas*, to lower montane forests, up to 1500 m altitude, on sandy clay soils.

48. **Lithocarpus pusillus** Soepadmo

(Latin, *pusillus* = very small, tiny; the cupule)

Reinwardtia 8 (1970) 270, *l.c.* (1972) 362; Cockburn *l.c.* (1976) 103; Anderson *l.c.* 202; Whitmore, Tantra & Sutisna *l.c.* 159; PROSEA *l.c.* 300. **Type:** *Anderson 4560*, Borneo, Sarawak, Miri district, G. Mulu NP (holotype L; isotypes A, K, S).

Tree up to 30 m tall, 80 cm diameter; buttresses up to 0.9 m tall. **Bark** scaly or flaky, greyish brown; inner bark reddish or brownish. **Sapwood** whitish. **Twigs** glabrescent, sparsely to densely minute- or usually large-lenticellate. **Stipules** linear, *c.* 3 × 1 mm. **Leaves** *thin-coriaceous*, *glabrous above*, *sparsely appressed brownish tomentose below*; *narrowly elliptic or ovate*, *(5.5–)6–8.5(–10.5) × 2–4 cm*, *base obtuse*, *margin strongly revolute*, *apex caudate or long-acuminate*, *acumen 10–25 mm long*; *midrib* thin, *flat above*, *strongly raised below*; *lateral veins* thin, 6–11 pairs, lax, flat above, slightly raised below, *faintly joining near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal* *venation reticulate*, dense, *obscure on both surfaces or thinly prominent below*; *petiole 5–9 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 7–10 cm long; bracts subrounded, 0.3–0.4 mm across; bracteoles ovate, *c.* 0.3 × 0.1 mm. **Male flowers** solitary along the rachis; perianth lobes acute, *c.* 0.8 × 0.6 mm; stamen filaments *c.* 2 mm long; pistillode globose, 1–1.5 mm diameter. **Androgynous** or **mixed inflorescences** (3–)8–10 cm long; bracts ovate, *c.* 0.4 × 0.2 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 0.7 × 0.3 mm; staminodes 10; styles conical, straight, *c.* 1 mm long. **Cupules** solitary along the rachis, *sessile*, *saucer-shaped*, *0.3–0.5 × 0.8–1(–1.2) cm*, densely appressed tomentose, *lamellate*; wall woody, thin, enclosing less than half of the acorn; lamellae slightly distinct, edge entire or minutely denticulate, set in 4–5 regular lines. **Acorns** *ovoid to conical*, (0.7–)1.5–1.8 × 0.7–1.5 cm, *most part exserted*, glabrous, brown; base flat, apex rounded to acute; *scar concave*, *0.3–0.7 cm diameter*; *wall bony*, *thin*, *most part free from the cupule.*

Vernacular names. Sarawak—*berangan bris* (Iban), *empenit daun halus*, *empenit gading* (Malay), *languwai* (Kedayan), *pili* (Kenyah), *saled* (Murut).

Distribution. Endemic to Borneo. In Sabah, recorded for Sipitang, Beaufort, Tawau, Tenom, and Kinabatangan districts. In Sarawak, common in Miri, Kapit, Sibu, Sri Aman, and Kuching districts. Also in Kalimantan.

Ecology. In primary hill mixed dipterocarp, peatswamp, *kerangas* to lower montane forests, at 400–1600 m altitude, on sandy loam or sandy clay soils.

49. **Lithocarpus rassa** (Miq.) Rehder

(A Malay plant name—*rasa*)

J. Arn. Arb. 1 (1919) 130; Soepadmo *l.c.* (1970) 271, *l.c.* (1972) 364; Cockburn *l.c.* (1972) 225, *l.c.* (1976) 105; Anderson *l.c.* 203; Corner *l.c.* 342; Whitmore, Tantra & Sutisna *l.c.* 159; Turner *l.c.* 237; PROSEA *l.c.* 301; Kochummen *l.c.* 248. **Basionym:** *Quercus rassa* Miq. *l.c.* (1861) 350. **Type:** *Teijsmann HB. 675*, Sumatra, Padang Residency, Pajakumbuh (holotype BO; isotypes K, U). **Synonyms:** *Cyclobalanus rassa* (Miq.) Oerst. *l.c.* (1871) 376; *Pasania rassa* (Miq.) Gamble *l.c.* (1915) 436; *Synaedrys rassa* (Miq.) Koidzumi *l.c.* (1916) 192; *Q. rassa* Miq. var. *montana* King *ex* Hook. *f. l.c.* (1888) 613; *Q. wenzigiana* King *ex* Hook. *f. l.c.* (1888) 613; *P. wenzigiana* (King *ex* Hook. *f.*) Gamble *l.c.* (1915) 435; *S. wenzigiana* (King *ex* Hook. *f.*) Koidzumi *l.c.* 193; *L. wenzigiana* (King *ex* Hook. *f.*) A. Camus *l.c.* (1932) 42; *Q. rassa* Miq. var. *lanuginosa* Ridl., J. Str. Br. Roy. As. Soc. 61 (1912) 37; *L. rangeriana* A. Camus *l.c.* (1932) 913; *L. ridleyana* A. Camus *l.c.* (1932) 913; *L. symingtonia* A. Camus *l.c.* (1932) 913.

Tree up to 24 m tall, 45 cm diameter. **Bark** fissured or scaly or smooth, greyish brown; inner bark reddish. **Sapwood** whitish. **Twigs** glabrescent, sparsely to densely large-lenticellate. **Stipules** linear, 3–4 × 1 mm. **Leaves** *thin-coriaceous*, *not rigid*, *glabrous above*, *sparsely appressed*, *greyish tomentose with short*, *simple hairs below*; narrowly elliptic, *(3–)6–9(–12) × (1.5–)2–4(–5.5) cm*, base acute to cuneate, margin strongly revolute, *apex acute to acuminate or caudate*, *acumen 10–18 mm long*; midrib raised on both surfaces; lateral veins thin, (8–)10–13(–15) pairs, dense, flat above, slightly raised below or obscure on both surfaces, faintly joining near the leaf margin, forming an angle of 40–50° with the midrib; *intercostal venation* reticulate, dense, *obscure on both surfaces* *or thinly prominent below*; *petiole (8–)10–15(–20) mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 4–12 cm long; bracts and bracteoles ovate, 0.9–1 × 0.5–0.6 mm. **Male flowers** in clusters of 2–3 along the rachis; perianth lobes obtuse, *c*. 1 × 0.5 mm; stamen filaments *c*. 2 mm long; pistillode subglobose, 0.8–1 mm diameter. **Androgynous** or **mixed inflorescences** 5–11 cm long; bracts and bracteoles ovate, 0.6–1 × 0.4–0.6 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c*. 0.8 × 0.6 mm; staminodes 10; styles conical, straight, 0.5–1 mm long. **Cupules** solitary along the rachis, sessile or with stalk 3–4 mm long, cup- or saucer-shaped, *1.3–1.7 × 2–3 (–3.5) cm*, sparsely appressed tomentose, *lamellate*; wall woody, thick, enclosing less than half of the acorn; lamellae clearly distinct, edge entire or denticulate, set in 6–8 regular lines. **Acorns** subglobose, 1.2–1.8 × 1.5–2.5 cm, *most part exserted*, glabrous, rarely sparsely tomentose, dark brown; base rounded, apex acute; scar deeply concave, 1–1.5 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Vernacular name. Sarawak—*keraki padi* (Bidayuh).

Distribution. Sumatra, Peninsular Malaysia and Borneo (Sabah and Sarawak). In Sabah, known only from Keningau, Tawau and Sipitang districts. In Sarawak, widely distributed throughout Kapit, Kuching, Miri, and Sri Aman districts.

Ecology. In primary lowland and hill mixed dipterocarp, *kerangas*, swamp and limestone forests, up to 1000 m altitude.

50. **Lithocarpus revolutus** Hatus. *ex* Soepadmo

(Latin, *revolutus* = rolled back from edge; the leaf margin)

Reinwardtia 8 (1970) 273, *l.c.* (1972) 346; Cockburn *l.c.* (1976) 100; Anderson *l.c.* 203; Whitmore, Tantra & Sutisna *l.c.* 159. **Type:** *RSNB 4171*, Borneo, Sabah, Mt. Kinabalu, Mesilau R. (holotype L; isotype K).

Tree up to 25 m tall, 50 cm diameter. **Bark** flaky, brownish; inner bark yellowish brown. **Sapwood** yellowish. **Twigs** glabrous, sparsely large-lenticellate. **Stipules** narrowly ovate, 4–6 × 2–3 mm. **Leaves** thick-coriaceous, rigid, *not bullate*, *glabrous on both surfaces*; *obovate to elliptic*, *10–14(–21.5) × 3–5(–7) cm*, base cuneate, *margin strongly revolute*, *apex rounded to obtuse*, tip emarginate; midrib broad, flat or impressed above, strongly raised; lateral veins thick, (5–)7–9 pairs, lax, flat to impressed above, strongly raised below, disappearing near the leaf margin, forming an angle of 45–60° with the midrib; *intercostal venation* subscalariform, dense, *obscure on both surfaces or thinly prominent below*; *petiole 5–6 mm long*. **Inflorescences** male or female. **Male inflorescences** 10–15 cm long; bracts ovate, 2–2.2 × 0.5–1 mm; bracteoles narrowly ovate, *c*. 1.2 × 0.3–0.6 mm. **Male flowers** solitary but arranged closely together along the rachis; perianth lobes obtuse, *c*. 1.8 × 0.8–1 mm; stamen filaments 2–3 mm long; pistillode subglobose, 0.8–1.2 mm diameter. **Female inflorescences** 8–14 cm long, sturdy; bracts and bracteoles narrowly ovate to linear, 1–2 × 0.3–0.5 mm. **Female flowers** solitary along the rachis; perianth lobes acute, 1 × 0.5 mm; staminodes 12; styles cylindrical, straight, *c*. 2 mm long. **Cupules** solitary along the rachis, sessile, cup-shaped, *1.5–2.5 × 3.7–5 cm*, densely tomentose, *scaly*; wall woody, thick, enclosing up to half of the acorn; scale-like appendages distinct, rarely obscure, appressed, imbricate, irregularly set. **Acorns** depressed ovoid, 2–2.3(–5) × 3–4.5 cm, *most part exserted*, glabrous, shining, dark chocolate-brown; base rounded, apex rounded to acute; scar concave, 2–3.5 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Vernacular name. Sarawak—*saled urong* (Kelabit).

Distribution. Endemic to Borneo, uncommon. In Sabah, recorded for Keningau, Kinabatangan and Ranau districts. In Sarawak, known only from Baleh in Kapit district, Sg. Masia in Lawas district, and in Bario district. Also in Kalimantan.

Ecology. In primary hill mixed dipterocarp, *kerangas*, and lower montane forests, at 1000–1800 m altitude.

51. **Lithocarpus rigidus** Soepadmo

(Latin, *rigidus* = stiff or rigid; the leaf)

Reinwardtia 8 (1970) 275, *l.c.* (1972) 357; Cockburn *l.c.* (1976) 105; Whitmore, Tantra & Sutisna *l.c.* 159. **Type:** *RSNB 4789*, Borneo, Sabah, Mt. Kinabalu, Mesilau Cave (holotype L; isotypes K, SAN, SING).

Tree up to 18 m tall, 30 cm diameter. **Bark** greyish brown. **Twigs** sparsely appressed tomentose or subglabrous, sparsely lenticellate. **Stipules** lanceolate, 6–8 × 3–4 mm. **Leaves** *thick-coriaceous*, *rigid*, *glabrous above*, *sparsely brownish appressed tomentose below*; obovate, *(7–)14–16(–18) × 6.5–8(–10) cm*, base acute to cuneate, decurrent, margin strongly revolute, *apex acute*; midrib broad, strongly raised above, slightly raised below; *lateral veins* thick and broad, 8–11 pairs, *lax*, flat or impressed above, slightly raised below, disappearing or faintly joining near the leaf margin, forming an angle of 50–70° with the midrib; *intercostal venation subscalariform or irregular*, lax, *obscure on both surfaces*; *petiole 6–10 mm long*. **Inflorescences** male or female. **Male inflorescences** 4–6 cm long; bracts linear, *c.* 2.7 × 0.8 mm; bracteoles elliptic, *c.* 1.3 × 0.6 mm. **Male flowers** solitary along the rachis; perianth lobes acute, *c.* 2 × 1 mm; stamen filaments *c.* 5 mm long; pistillode subglobose, 2–2.5 mm diameter. **Female inflorescences** 8–10 cm long; bracts and bracteoles ovate, 3–5 × 2–3 mm. **Female flowers** in clusters of 3 along the rachis; perianth lobes acute, 4–5 mm across; staminodes 12; styles conical, recurved, 1–2 mm long. **Cupules** in clusters of 2–3 or solitary along the rachis, sessile or with stalk *c.* 3 mm long, saucer- to cup-shaped, 0.5–0.7 × 1–1.5 cm, sparsely appressed tomentose, *lamellate*; wall woody, thick, enclosing less than half of the acorn; lamellae distinct, edge minutely denticulate, set in irregular lines. **Acorns** ovoid to conical, 0.8–1 × 1–1.5 cm, *most part exserted*, glabrous, dark chocolate-brown; base flat, apex rounded or acute; scar deeply concave, 0.5–1 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Endemic to Borneo. In Sabah, only known from Mesilau Cave, Mt. Kinabalu and Mt. Tambuyokon in Ranau district. Not known in Sarawak. Also occurs in Kalimantan.

Ecology. In montane forest up to 2700 m altitude.

52. **Lithocarpus rotundatus** (Blume) A. Camus

(Latin, *rotundatus* = rounded; the upper part of the cupule and acorn)

Riviera Scientific 18 (1931) 41; Soepadmo *l.c.* (1970) 275, *l.c.* (1972) 331; Whitmore, Tantra & Sutisna *l.c.* 159; PROSEA *l.c.* 301. **Basionym:** *Quercus rotundata* Blume, Verh. Bat. Genootsch. 9 (1823) 219. **Type:** *Blume s.n.*, Java, Mt. Salak (L). **Synonyms:** *Pasania rotundata* (Blume) Oerst. *l.c.* (1867) 83; *Synaedrys rotundata* (Blume) Koidzumi *l.c.* 189; *Q. clathrata* Seemen *l.c.* (1900) 15; *S. clathrata* (Seemen) Koidzumi *l.c.* (1916) 190; *L. clathrata* (Seemen) Rehder *l.c.* (1919) 123; *Q. pyriformis* Seemen *l.c.* (1900) 17; *S. pyriformis* (Seemen) Koidzumi *l.c.* (1916) 189; *L. pyriformis* (Seemen) Rehder *l.c.* (1919) 127.

Tree up to 40 m tall, 100 cm diameter. **Twigs** densely tomentose with simple and stellate hairs, late-subglabrescent, sparsely to densely warty lenticellate. **Stipules** linear, 4–5 × 0.7–1 mm. **Leaves** *thin-coriaceous*, glabrous above, densely greyish tomentose with appressed stellate hairs below; ovate to elliptic, (10–)13–15(–20) × (4–)5–6(–9) cm, *base rounded to acute*, margin slightly revolute, apex acute to sharply acuminate, acumen 5–10 mm long; midrib thin above, raised below; lateral veins thin, 9–11 pairs, impressed above, raised below, disappearing near the leaf margin, forming an angle of 45–60° with the midrib; intercostal venation subscalariform, dense, obscure on both surfaces; *petiole 5–15 mm long*. **Inflorescences** male or female. **Male inflorescences** 10–15 cm long; bracts and bracteoles ovate, 0.6–1 × 0.6 mm. **Male flowers** in clusters of 3–7 along the rachis; stamen filaments 3–4 mm long; pistillode subglobose, 1.5–2 mm diameter. **Female inflorescences** 10–15 cm long; bracts and bracteoles ovate, *c.* 1 × 0.7 mm. **Female flowers** solitary along the rachis; staminodes 12; styles conical, recurved, 1–1.5 mm long. **Cupules** solitary along the rachis, *obovoid or pear-shaped*, 1.5–2 × 3–4 cm, densely stellate-hairy, lower part smooth or ridged, *upper part rotundate*, set with *imbricate scale-like appendages or woody tubercules*; *stalk 5–20 mm long*; wall thick, *enclosing most part of the acorn except for an apical opening c. 1 cm diameter.* **Acorns** subglobose, *c.* 2 × 3–3.5 cm; *wall woody*, *thick*, *most part adnate to the cupule.*

Distribution. Java, Borneo and the Philippines. In Borneo, so far only known from Sabah and Kalimantan.

Ecology. In lowland mixed dipterocarp forest to lower montane forest, up to 1500 m altitude.

53. **Lithocarpus ruminatus** Soepadmo

(Latin, *ruminatus* = ruminate, intricately folded; the inner wall of the acorn)

Reinwardtia 8 (1970) 277, *l.c.* (1972) 328; Cockburn *l.c.* (1976) 105; Anderson *l.c.* 203; Whitmore, Tantra & Sutisna *l.c.* 159; Coode *et al.* (eds.) *l.c.* 127; Argent *et al.* (eds.) *l.c.* 251. **Type:** *Clemens 29164*, Borneo, Sabah, Mt. Kinabalu (holotype L; isotypes A, BM, BO, K, NY, UC).

Tree up to 20 m tall, 30 cm diameter; buttresses 0.3–0.6 m tall. **Bark** smooth or flaky, greyish brown; inner bark fissured, red-brown. **Sapwood** brownish or whitish. **Twigs** subglabrous, smooth or sparsely minute-lenticellate. **Stipules** linear, 2–4 × 1 mm, caducous or persistent. **Leaves** thin-coriaceous to coriaceous, *glabrous or subglabrous above*, *sparsely appressed greyish tomentose below*; elliptic, *10–13(–16) × (3–)4–6 cm*, base rounded, acute or cuneate, margin revolute, apex acute to shortly acuminate, acumen *c.* 10 mm long; *midrib* thin, *slightly raised above*, *strongly raised below*; lateral veins thin, 5–7 (–9) pairs, lax, impressed or flat above, raised below, disappearing near the leaf margin, forming an angle of 45–60° with the midrib; *intercostal venation subscalariform*, *lax*, obscure on both surfaces or thin and weakly prominent below; *petiole 5–15 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 6–12 cm long; bracts and bracteoles narrowly ovate, *c.* 1–1.5 × 0.5 mm. **Male flowers** in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 1.5 × 1 mm; stamen filaments *c.* 1 mm long; pistillode subglobose, *c.* 1.5 mm diameter. **Androgynous** or **mixed inflorescences** 8–10 cm long; bracts narrowly ovate, *c.* 1 × 0.5 mm; bracteoles obtuse, *c.*1 mm across. **Female flowers** in clusters of 3 along the rachis; perianth lobes acute, *c.* 1 × 0.5 mm; staminodes 12; styles cylindrical, straight, *c.* 2 mm long. **Cupules** solitary along the rachis, sessile, *ovoid to ellipsoid* 3–4.5 × 4–5 cm, sparsely tomentose, *lamellate*; wall woody, *c.* 0.5 cm thick, densely hairy, enclosing most part of the acorn except for an apical opening 1–1.5 cm diameter; lamellae distinct, edge entire, set in 7–10 concentric lines. **Acorns** ovoid to ellipsoid, 3–4 × 4–5 cm, free apical part sparsely tomentose, brown; base rounded, apex convex, depressed and umbonate; *wall thick*, *most part adnate to the cupule*, *inner part (endocarp) ruminate.*

Vernacular name. Sarawak—*salud kup* (Murut).

Distribution. Endemic to Borneo, uncommon. In Sabah, recorded for Sandakan, Ranau, Tawau, Tenom, Kota Belud, Sipitang, Beaufort, and Lahad Datu districts. In Sarawak, known only from Lanjak-Entimau, Ulu Segan in Bintulu district and Ulu Lawas in Lawas district. Also in Brunei and Kalimantan.

Ecology. In primary hill mixed dipterocarp, swamp, to lower montane forests, at 100–1300 m altitude, on clay soils.

54. **Lithocarpus sandakanensis** S. Julia & Soepadmo

(of Sandakan, Sabah)

Gard. Bull. Sing. 50 (1998) 143. **Type:** *Wood SAN A 4697,* Borneo, Sabah, Sandakan district, Sepilok FR, Compartment 17 (holotype KEP; isotypes AA, L, MEL, SING).

Tree up to 45 m tall, 90 cm in diameter; buttresses small. **Bark** smooth, greyish or brownish; inner bark yellowish. **Sapwood** whitish or purplish. **Twigs** glabrescent, sparsely lenticellate. **Leaves** coriaceous, *subglabrous above*, *sparsely appressed brownish tomentose below*; elliptic to oblong, *26–39(–46) × 7.5–11.5 cm*, base rounded to acute, margin revolute, apex sharply acute to acuminate, acumen *c.* 15 mm long; midrib flat or slightly raised above, strongly raised below; lateral veins thick, 11–14 pairs, dense, flat or impressed above, strongly raised below, disappearing near the leaf margin, forming an angle of 30–60° with the midrib; *intercostal venation subscalariform or reticulate*, lax, *prominent on both surfaces*, stronger below; *petiole 8–18 mm long*. **Male inflorescences** *c.* 10 cm long; bracts narrowly ovate to linear, 1–1.1 × 0.4 mm; bracteoles linear, *c.* 0.6 × 0.2 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, 1.1–1.3 × 0.6–0.8 mm; stamen filaments *c.* 2 mm long; pistillode subglobose, 0.6–1 mm in diameter. **Pistillate**

inflorescences and **flowers** not known. **Cupules** solitary along the rachis, with stalk 0.5–0.7 cm long, cup-shaped, 1.5–2 × 3–3.5 cm, densely tomentose, *lamellate*; wall woody, thick, enclosing up to half of the acorn; lamellae distinct, edge minutely denticulate or wavy, set in 7–8 regular lines. **Acorns** depressed ovoid, 3.5–4 cm across, *most part exserted*, *densely tomentose with simple hairs*, dark brown; base flat, apex rounded to acute; scar deeply concave, *c*. 2 cm in diameter; *wall woody*, *thick*, *most part free from the cupule*.

Distribution. Endemic to Sabah. All known specimens were collected from Sepilok FR in Sandakan district.

Ecology. In primary lowland mixed dipterocarp forest, on yellow clay soils, up to 15 m altitude.

55. **Lithocarpus sericobalanus** E.F. Warb.

(Greek, *serikos* = silky with long, straight, closely pressed glossy hairs, *balanos* = acorn)

Kew Bull. 20 (1936) 20 ; Soepadmo *l.c.* (1970) 279, *l.c.* (1972) 340; Cockburn *l.c.* (1976) 102; Anderson *l.c.* 203; Whitmore, Tantra & Sutisna *l.c.* 159; Kessler & Sidiyasa *l.c.* 142; PROSEA *l.c.* 302; Argent *et al.* (eds.) *l.c.* 251. **Type:** *Richards 1241*, Borneo, Sarawak, Mt. Dulit, Ulu Tinjar, Long Kapa (holotype K; isotypes A, L).

Tree up to 50 m tall, 100 cm diameter; buttresses up to 1.8 m tall. **Bark** deeply fissured or scaly, greyish brown; inner bark fibrous, yellowish brown. **Sapwood** yellowish or brownish. **Twigs** densely yellowish tomentose, sparsely lenticellate. **Leaves** coriaceous, *glabrous above*, *sparsely yellowish tomentose below*; elliptic, *(9–)12–13.5 × (3–)4–6 cm*, *base acute*, margin revolute, apex bluntly acute to acuminate, acumen 5–10(–15) mm long; *midrib raised on both surfaces*, stronger below; lateral veins thin, (9–)10–11(–12) pairs, dense, flat above, raised below, disappearing near the leaf margin, forming an angle of 40–60° with the midrib; *intercostal venation scalariform*, dense, *obscure above*, *prominent below*; *petiole 10–15(–20) mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 6–15 cm long; bracts elliptic, *c*. 0.8 × 0.4 mm; bracteoles ovate, 0.3–0.4 mm across. **Male flowers** solitary along the rachis; perianth lobes acute, *c*. 1 × 0.5 mm; stamen filaments 2–2.5 mm long; pistillode globose, *c*. 1 mm diameter. **Androgynous inflorescences** 10–15 cm long; bracts ovate, *c*. 0.5 × 0.3 mm; bracteoles subrounded, 0.2–0.3 mm across. **Female flowers** solitary along the rachis; perianth lobes acute, *c*. 0.7 × 0.5 mm; staminodes 12; styles conical, straight, 0.8–1 mm long. **Cupules** solitary along the rachis, *with stalk 5–10 mm long,* saucer-shaped, 0.5–1.5 × 2.5–4 cm, densely sericeous, *lamellate*; wall woody, thick, enclosing up to half of the acorn; lamellae slightly distinct or obscure, edge entire or denticulate, set in 6–10 regular lines. **Acorns** depressed ovoid to subglobose or discoid, 1–2 × 2.5–4 cm, *most part exserted*, *densely sericeous*, brownish; base rounded, apex rounded to acute; *scar deeply concave*, *2–3 cm diameter*; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Endemic to Borneo. Common and distributed throughout Sabah and Sarawak. Also in Kalimantan.

Ecology. Common in primary hill mixed dipterocarp forest, up to 1000 m altitude.

Uses. The timber is widely used by local people for house and bridge construction and also for making furniture and tool-handles.

56. **Lithocarpus stonei** S. Julia & Soepadmo Fig. 13.

(B.C. Stone, 1933–1994, former Reader in Botany, Department of Botany, University of Malaya, Kuala Lumpur)

Gard. Bull. Sing. 50 (1998) 145. **Type:** *Yap & Khairuddin SAN 106051*, Borneo, Sabah, Tambunan road (holotype SAN; isotype KEP).

Tree up to 25 m tall, 60 cm in diameter. **Bark** fissured or smooth or lenticellate, dark grey; inner bark fibrous, yellowish brown or whitish. **Sapwood** whitish. **Twigs** densely tomentose, sparsely to densely large-lenticellate. **Leaves** *thick-coriaceous*, *rigid*, *sparsely appressed yellowish tomentose on both surfaces*; elliptic to oblong, 28–36(–40) × 9–14 cm, *base rounded to acute*, margin revolute, apex acuminate, acumen *c*. 15 mm long; *midrib strongly raised on both surfaces*, stronger below; *lateral veins* thick, (9–)10–12 pairs, *lax*, flat or impressed above, strongly raised below, *disappearing near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation reticulate*, *lax*, *obscure above*, *prominent below*; *petiole 10–15 mm long*. **Male inflorescences** and **flowers** unknown. **Female inflorescences** *c*. 20 cm long; bracts narrowly ovate, 2–2.5 × 0.2–0.5 mm; bracteoles broadly ovate, *c*. 0.7 × 0.5 mm. **Female flowers** in clusters of 2–3 along the rachis; perianth lobes acute, *c*. 1 × 0.5 mm; staminodes 12; styles conical, straight, *c*. 1.5 mm long. **Cupules** in clusters of 2–3 or rarely solitary along the rachis, sessile, deeply cup-shaped, *2–3 × 4–5 cm*, densely tomentose, *lamellate*; wall woody, 3–5 mm thick, enclosing half or more of the acorn; *lamellae strongly raised*, *edge folded inwards*, *undulate*, set in 7–9 regular or irregular lines. **Acorns** depressed ovoid to subglobose, *3–4 × 3–5 cm*, *most part exserted*, *glabrous* and shining, brownish; base flat, apex rounded; *scar deeply concave*, *2–2.5 cm in diameter*; *wall woody*, *thick*, *most part free from the cupule*.

Vernacular name. Sarawak—*saled urong* (Kelabit).

Distribution. Endemic to Borneo. In Sabah, recorded for Crocker Range in Tenom district, and G. Alab and Tambunan road in Tambunan district. In Sarawak, known only in Ulu Baram in Marudi district. No record for Brunei and Kalimantan.

Ecology. In hill mixed dipterocarp forest, on recent alluvium and clay soils, up to 1000 m altitude.

57. **Lithocarpus sundaicus** (Blume) Rehder

(of the Sundalands)

J. Arn. Arb. 1 (1919) 131; Soepadmo *l.c.* (1970) 282, *l.c.* (1972) 375; Cockburn *l.c.* (1972) 226, *l.c.* (1976) 97; Anderson *l.c.* 203; Corner *l.c.* 342; Whitmore, Tantra & Sutisna *l.c.* 160; Turner *l.c.* 238; PROSEA *l.c.* 304; Argent *et al.* (eds.) *l.c.* 251. **Basionym:** *Quercus sundaica* Blume *l.c.* (1823) 216. **Type:** *Blume s.n. (= RHL Sheet No. 90131341)*, W Java, Banten Residency, Sadjira, Rangkas Bitung (holotype L; isotype CGE). **Synonyms:** *Pasania sundaica* (Blume) Oerst. *l.c.* (1867) 83; *Q. pseudomolucca* Blume var. *sundaica* (Blume) Wenzig, Jahrb. Bot. Gart. Berl. (1886) 227; *Synaedrys sundaica* (Blume) Koidzumi *l.c.* (1916) 198; *Q. pruinosa* Blume *l.c.* (1823) 217, *t.* 5; *P. pruinosa* (Blume) Wenzig *l.c* (1886) 227; *S. pruinosa* (Blume) Koidzumi *l.c.* 197; *L. pruinosa* (Blume) Rehder *l.c.* (1919) 130; *Castanea latifolia* Blume, Bijdr. Fl. Ned. Ind. (1826) 526; *Q. muricata* Roxb. *l.c.* (1832) 635;

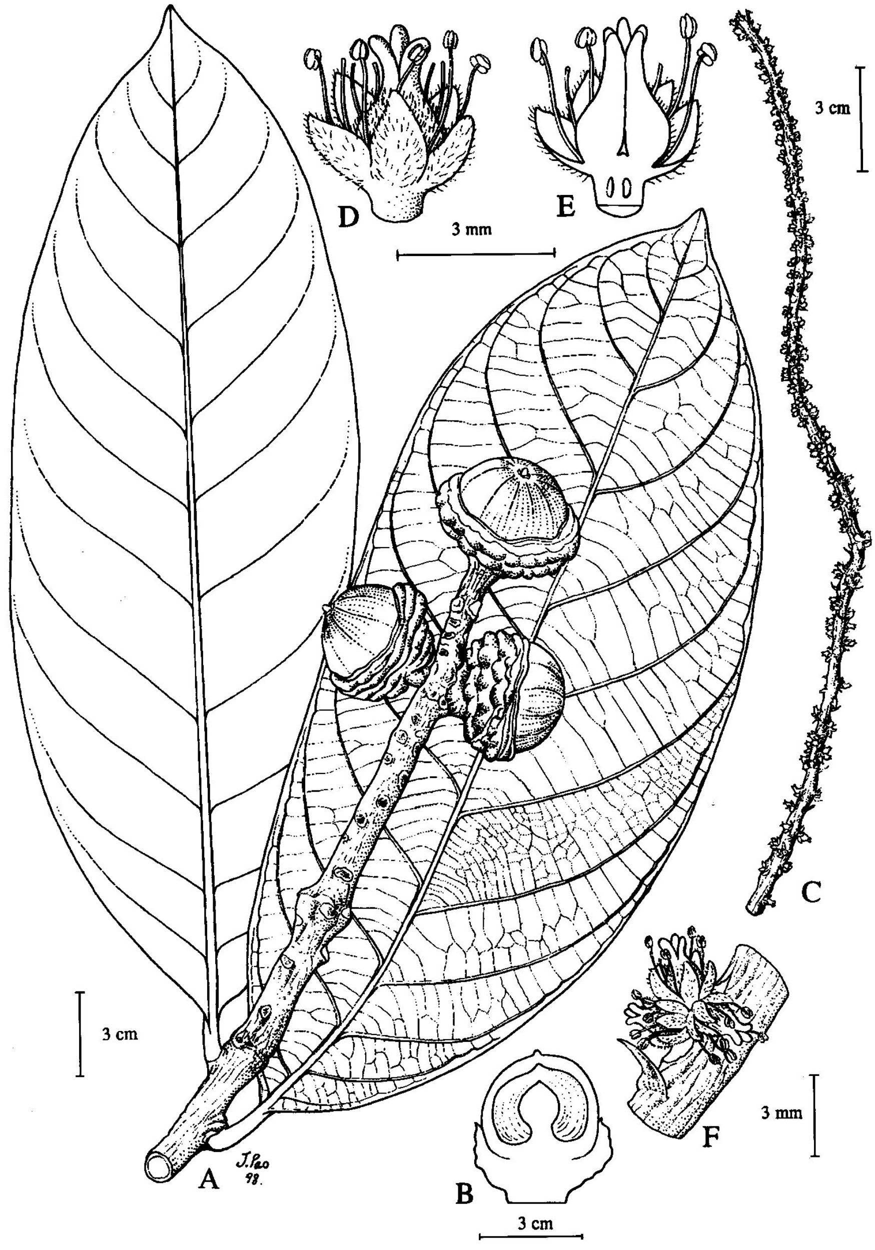

Fig. 13. *Lithocarpus stonei*. A, leafy fruiting twig; B, longitidunal section of cupule and acorn; C, female inflorescence; D, female flower; E, longitidunal section of female flower; F, 3-flowered dichasial cluster of female flowers. (A–B from *SAN 106051*, C–F from *SAN 136522*.)

Cyclobalanus muricata (Roxb.) Oerst. *l.c.* (1871) 379; *Q. mappacea* Korth. *l.c.* (1844) 202; *Q. korthalsii* Blume var. *mappacea* (Korth.) Blume *l.c.* (1850) 292; *Q. hystrix* Korth. var. *mappacea* (Korth.) Merr. *l.c.* (1921) 213; *Q. korthalsii* Blume *l.c.* (1850) 292; *P. korthalsii* (Blume) Oerst. *l.c.* (1867) 85; *Q. pseudomolucca* Blume var. *korthalsii* (Blume) Wenzig *l.c.* (1886) 227; *Q. lamponga* Miq. *l.c.* (1861) 348; *Cyclobalanus lamponga* (Miq.) Oerst. *l.c.* (1867) 81; *P. lamponga* (Miq.) Gamble *l.c.* (1915) 423; *S. lamponga* (Miq.) Koidzumi *l.c.* 195; *Q. grandifrons* King *ex* Hook. *f. l.c.* (1888) 610; *P. grandifrons* (King *ex.* Hook. *f.*) Gamble *l.c.* (1915) 421; *S. grandifrons* (King *ex.* Hook. *f.*) Koidzumi *l.c.* 195; *L. grandifrons* (King *ex.* Hook. *f.*) A. Camus *l.c.* (1932) 40.

Tree up to 36 m tall, 90 cm diameter. **Bark** smooth or fissured, greyish brown; inner bark yellowish. **Sapwood** yellowish. **Twigs** densely appressed tomentose with stellate and simple hairs, smooth or sometimes sparsely minute-lenticellate. **Stipules** linear, *c.* 4 × 1 mm. **Leaves** coriaceous, *densely or sparsely stellate-hairy (sometimes mixed with simple hairs) above*, *densely appressed greyish tomentose with simple and stellate hairs below*; *elliptic to oblong*, (10–)12–16(–24) × (4–)5–6(–10) cm, base obtuse, rarely acute, margin revolute, apex acute to acuminate, acumen 5–20 mm long; midrib strongly raised on both surfaces; lateral veins thick, (10–)12–14(–16) pairs, lax, slightly raised above, strongly raised below, faintly to clearly joining near the leaf margin, forming an angle of 40–60° with the midrib; *intercostal venation scalariform*, lax, obscure above, prominent or obscure below; *petiole 5–12 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 5–15 cm long; bracts ovate, *c.* 1 × 0.7 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1 × 1 mm; stamen filaments *c.* 2.5 mm long; pistillode globose, *c.* 1 mm diameter. **Androgynous** or **mixed inflorescences** 9–12 cm long; bracts and bracteoles broadly ovate, 0.8–1 × 0.6–0.8 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 0.5 × 0.3 mm; staminodes 10; styles conical, straight, *c.* 1 mm long. **Cupules** solitary along the rachis, sessile or with stalk 5–10 mm long, *saucer-shaped*, *0.3–0.7 × 1.4–2.5 cm*, densely tomentose with simple hairs, *scaly*; wall woody, thin, *enclosing less than half of the acorn*; scale-like appendages distinct, appressed, set in regular lines. **Acorns** depressed ovoid, 1.3–2 × 1.6–2 cm, *most part exserted*, *glabrous except for a small part at the apex which is densely tomentose with stellate and simple hairs*, purplish brown; base rounded, apex acute; scar concave or flat, 1–1.5 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore, Java, Borneo, and the Philippines. Widely distributed in Sabah. In Sarawak, recorded for Kapit, Miri, Kuching, and Sri Aman districts. Also in Brunei and Kalimantan.

Ecology. In primary and secondary mixed dipterocarp, *kerangas*, limestone, riparian to lower montane forests, up to 1500 m altitude.

58. **Lithocarpus tawaiensis** S. Julia & Soepadmo

(of Bt. Tawai, Sabah)

Gard. Bull. Sing. 50 (1998) 148. **Type:** *Berhaman et al. SAN 134267*, Borneo, Sabah, Bt. Tawai (holotype KEP).

Stunted treelet up to 1.5 m tall, 5 cm in diameter. **Bark** pale brown. **Twigs** sparsely appressed tomentose, smooth. **Stipules** broadly ovate, 10–13 × 10–18 mm. **Leaves** *sessile*, thick-

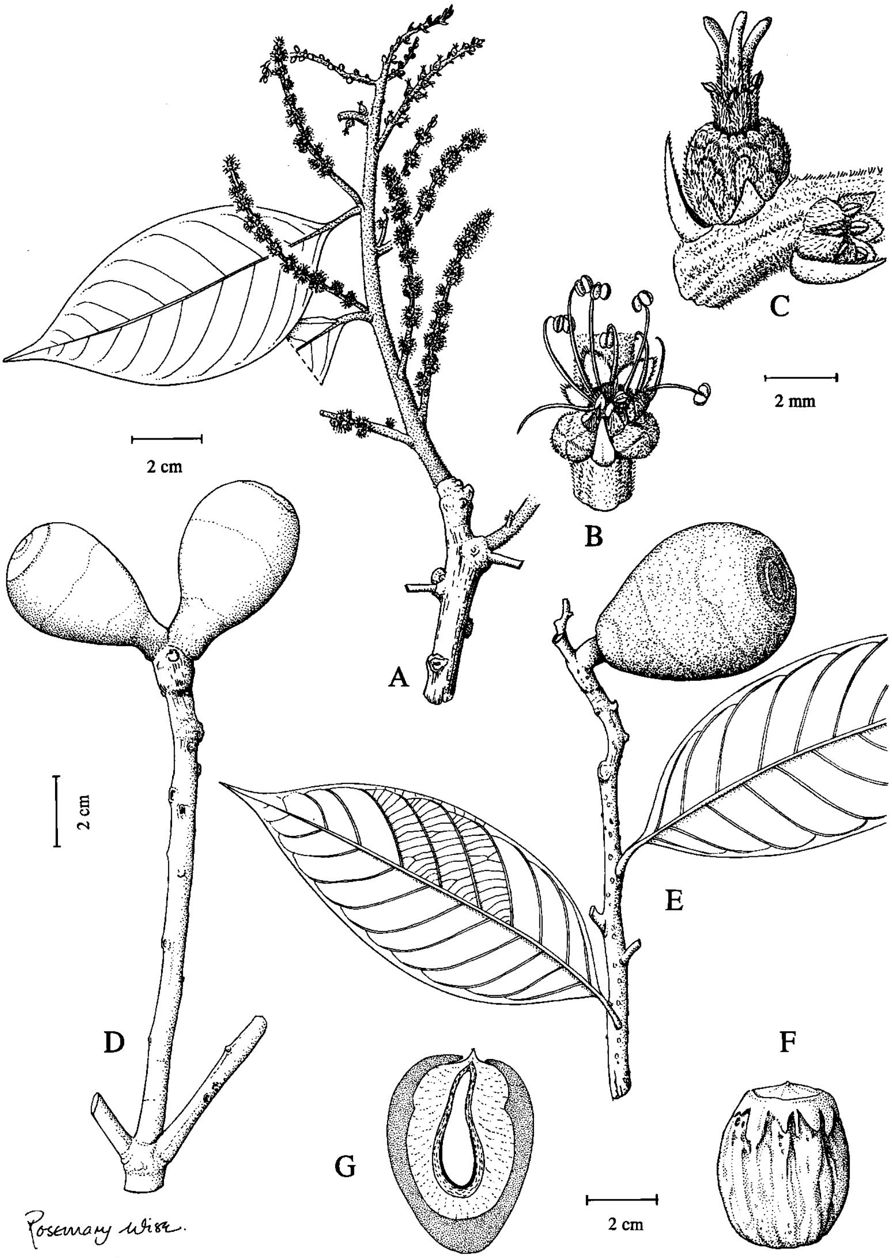

Fig. 14. *Lithocarpus turbinatus.* A, leafy flowering twig; B, cluster of 3 male flowers; C, female flower; D, young infructescence; E, leafy fruiting twig; F, acorn with its cupule removed; G, longitidunal section of cupule and acorn. (A–C from *SAN 29053*, D–E from *SAN 31786*, F–G from *S. 20209*.)

coriaceous, rigid, glabrous above, sparsely appressed yellowish tomentose or glabrescent below; ovate to suborbicular, 6.5–10.5 × 6–9 cm, base cordate, margin revolute, apex acute to acuminate; midrib raised on both surfaces, slightly stronger below; lateral veins thin, 10–12 pairs, dense, flat and almost invisible on both surfaces, faintly joining near the leaf margin, forming an angle of 30–60° with the midrib; intercostal venation reticulate, dense, obscure above, slightly prominent below. **Male inflorescences** 6–15 cm long; bracts and bracteoles ovate, 0.6–0.8 × 0.4–0.6 mm. **Male flowers** solitary or in clusters of 2–3 along the rachis; perianth lobes obtuse to acute, *c*. 1.2 × 0.7 mm; stamen filaments *c*. 2 mm long; pistillode globose, *c*. 0.5 mm in diameter. **Pistillate inflorescences** and **flowers** unknown. **Young cupule** solitary along the rachis, sessile, saucer-shaped, 1–1.3 × 0.3–0.4 cm, *scaly*, enclosing less than half of the acorn; scale-like appendages distinct, set irregularly. **Acorns** exserted, most part free from the cupule.

Distribution. Endemic to Borneo. Twice collected from Bt. Tawai, Telupid, Sandakan district, Sabah.

Ecology. In hill forest on ultrabasic soils, at about 400 m altitude.

59. **Lithocarpus turbinatus** (Stapf) Forman Fig. 14.

(Latin, *turbinatus* = shape like a top or inverted cone; the cupule and acorn)

Kew Bull. 18, 3 (1966) 423; Soepadmo *l.c.* (1970) 284, *l.c.* (1972) 329; Cockburn *l.c.* (1976) 100; Anderson *l.c.* 203; Whitmore, Tantra & Sutisna *l.c.* 160. **Basionym:** *Castanopsis turbinata* Stapf, FMK (1894) 232. **Type:** *Haviland 1102*, Borneo, Sabah, Mt. Kinabalu (holotype K).

Tree up to 30 m tall, 50 cm diameter. **Bark** flaky, reddish; inner bark granular, yellowish. **Sapwood** yellowish. **Twigs** sturdy with thick nodes, densely tomentose, late-subglabrescent, smooth or sparsely large-lenticellate. **Stipules** narrowly ovate to linear, *c*. 4 × 2 mm. **Leaves** *thick-coriaceous*, *rigid*, *glabrous above* except the midrib, *densely yellowish tomentose with stellate-hairs below*; ovate to elliptic, (6–)8–12(–13.5) × 3–5(–8) cm, base rounded or acute, margin strongly revolute, apex acute to acuminate, acumen 10–15 mm long; midrib flat or impressed above, strongly raised below; *lateral veins* thick, 6–9 pairs, lax, impressed or rarely flat above, strongly raised below, *clearly joining near the leaf margin*, forming an angle of 30–60° with the midrib; *intercostal venation scalariform*, *lax* or rarely dense, obscure above, thin and clearly prominent below; *petiole 8–13 mm long*. **Inflorescences** male, female, androgynous or mixed. **Male inflorescences** 5–7 cm long; bracts and bracteoles ovate, 0.5–1 mm across. **Male flowers** solitary along the rachis; perianth lobes acute, *c*. 1.5 × 1 mm; stamen filaments *c*. 1.5 mm long; pistillode subglobose, *c*. 2 mm diameter. **Female, androgynous** or **mixed inflorescences** sturdy, 4–6 cm long; bracts and bracteoles ovate, *c*. 1 × 0.5 mm. **Female flowers** solitary or in clusters of 3 along the rachis; perianth lobes acute, 1.5–2 mm across; staminodes 12; styles conical, straight, 2.5–3 mm long. **Cupules** solitary along the rachis, sessile or with stalk *c*. 5 mm long, *turbinate to ellipsoid*, *5–7 × 3.5–5 cm*, sparsely tomentose, *lamellate*; wall woody, *c*. 0.5 cm thick, sparsely hairy and sometimes lenticellate, *enclosing most part of the acorn except for an apical opening 0.5–1 cm diameter*; *lamellae distinct but not raised or rarely obscure*, *edge denticulate especially the upper ones*, set in regular 8–10 lines. **Acorns** ellipsoid, 5–6 × 4–5 cm, free apical part sparsely tomentose, brown; base rounded to acute, apex obtuse to flat; *wall woody*, *thick*, *most part adnate to the cupule*.

Distribution. Endemic to Borneo. Uncommon in Sabah and Sarawak. In Sabah, known from Ranau (especially Kinabalu Park), Tenom, and Tambunan districts. In Sarawak, reported for Bario, Ulu Sg. Kayan in Belaga district and G. Mulu NP in Miri district. Also in Kalimantan.

Ecology. In primary and secondary hill mixed dipterocarp forest to montane mossy forest, at 800–2600 m altitude, on sandy and ultrabasic soils.

60. **Lithocarpus urceolaris** (Jack) Merr.

(Latin, *urceolaris* = pitcher-shaped; the cupule)

J. Arn. Arb. 33 (1952) 241; Soepadmo *l.c.* (1970) 285, *l.c.* (1972) 344; Cockburn *l.c.* (1972) 226, *l.c.* (1976) 114; Anderson *l.c.* 203; Corner *l.c.* 342; Whitmore, Tantra & Sutisna *l.c.* 160; Turner *l.c.* 238; PROSEA *l.c.* 304; Coode *et al.* (eds.) *l.c.* 127; Argent *et al.* (eds.) *l.c.* 252. **Basionym:** *Quercus urceolaris* Jack *l.c.* 86. **Neotype** (Merrill, 1952)**:** *Grashoff 951*, Sumatra, Palembang, Banjumasin (holoneotype L; isoneotype BO). **Synonyms:** *Pasania urceolaris* (Jack) Oerst. *l.c.* (1867) 83; *Q. oligoneura* Korth. *l.c.* (1844) 203; *P. oligoneura* (Korth.) Oerst. *l.c.* (1867) 84; *P. craterophora* Fischer, Kew Bull. (1932) 319; *L. craterophora* (Fischer) A. Camus *l.c.* (1935) 75.

Tree up to 35 m tall, 70 cm diameter. **Bark** fissured, lenticellate, pale reddish brown; inner bark fibrous, brownish. **Sapwood** brownish. **Twigs** sparsely to densely tomentose, sparsely or densely lenticellate. **Stipules** narrowly ovate to linear, 2–3 × 1 mm. **Leaves** coriaceous, *sparsely to densely tomentose or sometimes glabrous above*, *densely tomentose with appressed stellate or sometimes mixed with stiff hairs below*; elliptic, obovate, oblong or lanceolate, 12–16.5(–35) × 5–9(–10) cm, base acute to cuneate, rarely rounded, margin revolute, apex sharply acute to acuminate, acumen 10–25 mm long; midrib broad, flat or slightly raised above, strongly raised below; lateral veins thin, (6–)7–12 pairs, lax, flat or impressed or sometimes obscure above, raised below, disappearing near the leaf margin, forming an angle of 40–60° with the midrib; *intercostal venation scalariform*, dense, obscure above, thin and prominent below; *petiole 5–8 mm long*. **Inflorescences** male or androgynous. **Male inflorescences** 15–20(–25) cm long; bracts elliptic, *c.* 1 × 0.3 mm; bracteoles linear, *c.* 0.5 × 0.2 mm. **Male flowers** solitary along the rachis; perianth lobes obtuse, *c.* 1 × 0.9 mm; stamen filaments 2–3 mm long; pistillode globose, *c.* 0.5 mm diameter. **Androgynous inflorescences** 12–25 cm long; bracts ovate, *c.* 0.8 × 0.5 mm. **Female flowers** solitary along the rachis; perianth lobes acute, *c.* 1 × 0.6 mm; staminodes 10; styles conical, recurved, 1–1.5 mm long. **Cupules** solitary or rarely in clusters of 3 along the rachis, with stalk 5–8 mm long, *cup-shaped*, *(0.5–)1.5–3.5 × 2.5–3.5 cm*, densely tomentose, *minutely scaly or lamellate*; wall woody, thick, densely hairy, *enclosing up to half of the acorn*; lamellae obscure, or if scaly, the scale-like appendages distinct, set in irregular lines. **Acorns** depressed globose, 2–4 × 2–3.5 cm, *most part exserted*, *densely tomentose*, brownish; base flat, apex acute or rounded; scar concave, 1–1.5 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Sumatra, Peninsular Malaysia and Borneo. Common and widespread throughout Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary and secondary mixed dipterocarp, peatswamp, riparian, *kerangas* to lower montane forests, up to 1200 m altitude, on various types of soils.

61. **Lithocarpus wallichianus** (Lindl. *ex* Hance) Rehder

(N. Wallich, 1786–1854, Danish botanist at Calcutta)

J. Arn. Arb. (1919) 132; Soepadmo *l.c.* (1970) 287, *l.c.* (1972) 368; Cockburn *l.c.* (1972) 227; Anderson *l.c.* 203; Corner *l.c.* 342; Whitmore, Tantra & Sutisna *l.c.* 160; Turner *l.c.* 238; PROSEA *l.c.* 305; Kochummen *l.c.* 249. **Basionym:** *Quercus wallichiana* Lindl. *ex* Hance *l.c.* (1870) 4. **Type:** *Wallich Cat. 2778*, Peninsular Malaysia, Penang, Penang Hill (holotype K; isotypes BM, CGE). **Synonyms:** *Pasania wallichiana* (Lindl. *ex* Hance) Gamble *l.c.* (1915) 425; *Synaedrys wallichiana* ("Lindl. *in* Wall.") Koidzumi *l.c.* 199; *Q. hystrix* Korth. var. *longispica* Gamble *l.c.* (1915) 429.

Tree up to 40 m tall, 90 cm diameter. **Bark** scaly, greyish; inner bark fibrous, greyish. **Sapwood** yellowish or brownish. **Twigs** densely tomentose, late-glabrescent, fissured or densely minute-lenticellate. **Stipules** linear, *c.* 3 × 1 mm. **Leaves** coriaceous, sometimes rigid, *sparsely appressed tomentose above*, *densely appressed tomentose with simple and stellate-hairs below*; elliptic to oblong, 8.5–15(–19) × 2–5(–6) cm, base acute to cuneate, margin revolute, apex acuminate, acumen 8–12 mm long; midrib strongly raised on both surfaces; *lateral veins* thick, (8–)11–15(–18) pairs, dense, impressed or flat above, strongly raised below, *clearly joining near the leaf margin*, forming an angle of 40–60° with the midrib; *intercostal venation subscalariform*, dense, obscure above, strongly prominent below; *petiole 5–8 mm long*. **Inflorescences** male, androgynous or mixed. **Male inflorescences** 6–12 cm long; bracts and bracteoles ovate to triangular, 1.2–1.8 × 1 mm. **Male flowers** solitary along the rachis; perianth lobes acute, *c.* 1.2 × 1 mm; stamen filaments *c.* 2 mm long; pistillode subglobose, 1–1.5 mm diameter. **Androgynous** or **mixed inflorescences** 10–17 cm long; bracts and bracteoles ovate, 1.5–2 × 1.2 mm. **Female flowers** in clusters of 3 along the rachis; perianth lobes obtuse, *c.* 1 × 0.6 mm; staminodes 10; styles cylindrical, straight, *c.* 1 mm long. **Cupules** *in clusters of 2–3 and closely arranged along the rachis*, sessile, saucer-shaped, 0.3–0.5(–0.7) × 1–1.5 cm, densely tomentose with simple and stellate hairs, *scaly*; wall woody, thin, enclosing less than half of the acorn; scale-like appendages slightly distinct or obscure, appressed, set in irregular lines. **Acorns** ovoid, 1–1.7 cm across, *most part exserted*, densely tomentose with simple hairs, brownish; base flat, apex acute or rounded; scar deeply concave, *c.* 0.5 cm diameter; *wall woody*, *thick*, *most part free from the cupule.*

Distribution. Thailand, Peninsular Malaysia, Singapore, and Borneo. In Borneo uncommon. In Sabah, known only from Nabawan in Keningau district. In Sarawak, recorded for Semengoh Arboretum and Mt. Santubong in Kuching district, and Ulu Sg. Kayan in Lundu district. Also in Brunei.

Ecology. In hill mixed dipterocarp forest, up to 500 m altitude.

Use. The acorns are edible but somewhat bitter.

3. **QUERCUS** L.

(Latin, *quercus* = the oak tree)

empili (Iban); *empenit*, *mempening* (Malay)

Gen. Pl., ed. 5 (1754) 431; Hooker *f.*, Fl. Br. Ind. 5 (1888) 600; King, Ann. Roy. Bot. Gard. Calc. 2

(1889) 19; Ridley, FMP 3 (1924) 372; A. Camus, Chênes 1 (1938) 311; Burgess, TBS (1966) 289; Soepadmo, Gard. Bull. Sing. 21 (1966) 379, *ibid.* 22 (1968) 355, FM 1, 7 (1972) 385; Cockburn, TFM 1 (1972) 228, TS 1 (1976) 116; Anderson, CLST (1980) 203; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 160; Kubitzki *in* Kubitzki *et al.* (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 308; PROSEA 15, 2 (1995) 409; Coode *et al.* (eds.), CLBD (1996) 127; Argent *et al.* (eds.), MNDT-CK 1 (1997) 252. **Synonyms:** *Cyclobalanopsis* Oerst., Vid. Medd. Nat. For. Kjöbn. 8 (1867) 77; *Quercus* L. subgen. *Cyclobalanopsis* (Oerst.) Schneider, Ill. Handb. Laubh. 1 (1906) 210.

Trees; buttresses and stilt-roots sometimes present. *Wood with narrow-uniseriate and broad-multiseriate rays*. **Bark** smooth, flaky or cracked; inner bark of various colour, sometimes fibrous, *with ridges growing into the sapwood*. **Sapwood** of various colour. **Twigs** initially densely tomentose by simple or stellate hairs or densely brownish, stiff pubescent, glabrescent, smooth, finely fissured or lenticellate. *Terminal buds ovoid*, *globose*, *or conical*, *crowded at the end of twigs*. **Stipules** extrapetiolar, linear, acute, densely tomentose or woolly pubescent, caducous. **Leaves** *spirally arranged*, *crowded near the end of twigs or rarely pseudowhorled*; margin entire, plane or sometimes revolute, or *remotely serrulate in the apical half*; *petiole thickened at the base*. **Inflorescences** male or female spikes, unbranched or rarely branched. **Male inflorescences** *pendent*, *unbranched*, solitary in the axils of lower (proximal) leaves, or in paniculate clusters on lateral new short shoots; bracts and bracteoles densely tomentose or minutely hairy, caducous. **Male flowers** solitary or in dichasial clusters of 3–4 along the rachis; perianth (4–)6-lobed, densely tomentose, stamens (4–)6(–9), *anthers basifixed*, filaments slender, filiform, glabrous or tomentose at the base; *pistillode absent* or rarely replaced by a tuft of stiff simple hairs. **Female inflorescences** solitary in the axils of upper (distal) leaves, erect; bracts densely pubescent, caducous. **Female flowers** solitary or in pairs along the rachis; perianth (4–)6(–9)-lobed, *staminodes absent* or rarely up to 6; ovary 3(–6)-loculed, styles 3(–6), cylindrical, recurved, *stigma broadly capitate or globose*. **Cupules** cup- or saucer-shaped, *each surrounding/substending a single fruit*, *lamellate*; edge of lamellae entire, undulate or denticulate, free or connate, pubescent, tomentose or woolly pubescent on both surfaces. **Fruits** (acorns) ovoid, conical, subglobose or cylindrical, *rounded in cross-section*, glabrous and shining or densely tomentose, apex depressed, *distinctly umbonate*; *umbo with many rings*; base flat, convex or concave; wall woody, its most part free from the cupule.

Distribution. About 400 species, widely distributed in temperate, subtropical and tropical regions, mainly of the northern hemisphere. In Malesia, found in Sumatra, Peninsular Malaysia, Singapore, Java, Borneo, and the Philippines (Palawan). Seventeen species are recorded for Sabah and Sarawak, of which 4 are endemic.

Ecology. In lowland mixed dipterocarp to montane forest, from sea level up to 3350 m altitude, but more commonly found at 600–1500 m altitude, on sandy clay, sandy loam and ultrabasic soils overlying sandstone or granite.

Use. Source of medium hardwood timber.

Key to *Quercus* species

(for sterile specimens)

1. Petiole (1–)3–5(–10) mm long. Leaf apex rounded, obtuse, or emarginate…..……..…2
   Petiole (10–)20–40(–50) mm long. Leaf apex acute, acuminate or caudate..…..………4

2. Leaves pseudowhorled, 6–17 × 3–6.5 cm; base rounded, cordate to auriculate; lateral veins 8–15 pairs……………………………..............…………..…**13. Q. pseudoverticillata**
Leaves spirally arranged, 1.5–5.5 × 0.8–3.5 cm; base attenuate, acute, or obtuse; lateral veins 4–8 pairs.......………………………..……………...…………………………………3

3. Leaves glabrous above, sparsely hairy below; margin entire, apex rounded, obtuse, or emarginate; lateral veins 4–5(–6) pairs; petiole up to 3 mm long, glabrous…...…… ………..…………………………………………………………...………**2. Q. chrysotricha**
Leaves initially densely pubescent on both surfaces, late-glabrescent; margin remotely serrulate in the apical half, apex obtuse; lateral veins (5–)6–8 pairs; petiole 2–6 mm long, densely tomentose........…………………………...……………………**10. Q. merrillii**

4. Leaves (7–)10–18(–25) × (2–)4–7(–9) cm.......………….…..……………………………...5
Leaves (4–)5–10(–16) × 2–4(–5.5) cm.......……………....……………………………...13

5. Leaf margin entire and revolute.......……………………………….....……………………6
Leaf margin plane, remotely serrulate, serrate, or crenate in the apical half……………......7

6. Older twigs sparsely tomentose with stellate hairs, shallowly fissured. Leaves glaucous and sparsely tomentose beneath, lateral veins (6–)7–10(–12) pairs….…..……**11. Q. nivea**
Older twigs glabrous, densely warty lenticellate. Leaves densely silvery tomentose beneath, lateral veins (10–)12–18 pairs.......……………………...…...…..**1. Q. argentata**

7. Older leaves glabrous on both surfaces or glabrous above, glabrescent beneath…….…8
Older leaves variously hairy at least beneath………………………………………….……9

8. Leaves thick-coriaceous; lateral veins 10–15 pairs, closely spaced, strongly raised beneath; intercostal venation dense, scalariform, prominent beneath………….………… ………………………………………………………………...…………**17. Q. valdinervosa**
Leaves thin-coriaceous; lateral veins 7–10 pairs, distantly spaced, slightly raised beneath; intercostal venation lax, reticulate, obscure on both surfaces or slightly raised beneath……………………………………………………...…………...**5. Q. gemelliflora**

9. Leaves densely greyish brown pubescent with appressed, straight simple hairs beneath; lateral veins 15–20 pairs, closely spaced…...………………......……………..**8. Q. lineata**
Leaves sparsely or densely tomentose with stellate hairs, or sparsely pubescent with stiff simple hairs beneath; lateral veins (6–)8–12(–15) pairs, distantly spaced.......….......10

10. Leaves sparsely tomentose with stellate hairs and pale glaucous beneath; base rounded………..………………………………………………...…..**12. Q. percoriacea**
Leaves densely greyish brown tomentose, or sparsely tomentose with stellate hairs or sparsely pubescent with stiff, simple hairs beneath; base attenuate, acute..………....…..11

11. Leaf apex acuminate, acumen 10–15 mm long; intercostal venation subscalariform.… ……………………………………………………………………………...…**3. Q. elmeri**
Leaf apex acute; intercostal venation scalariform.......…………………………………...12

12. Lower surface not glaucous, sparsely tomentose with brownish stellate hairs; intercostal venation distinct below.......…………………………..………………….**4. Q. gaharuensis**

Lower surface glaucous and sparsely pubescent with stiff, simple hairs; intercostal venation obscure on both surfaces……..……………………......………..**15. Q. sumatrana**

13. Leaves linear to narrowly lanceolate, densely pubescent with simple minute hairs beneath……...……………………………………………...……….**16. Q. treubiana**
Leaves elliptic, lanceolate or ovate, glabrous on both surfaces or glabrous above and densely to sparsely tomentose with silky stellate hairs beneath……………...………...14

14. Petiole grooved on the adaxial side. Intercostal venation reticulate.......……..………..15
Petiole flat on the adaxial side. Intercostal venation scalariform……………………...16

15. Leaves thick-coriaceous, ovate to elliptic, base rounded or cordate, lower surface densely tomentose with stellate hairs, late-glabrescent; intercostal venation distinct above, obscure beneath………………………………….................…..…**9. Q. lowii**
Leaves thin-coriaceous, elliptic to lanceolate, base attenuate or acute, lower surface sparsely tomentose with silky stellate hairs to glabrous; intercostal venation obscure on both surfaces.…………………………...……………………..**14. Q. subsericea**

16. Leaves elliptic or lanceolate, glabrous on both surfaces, glaucous below; base attenuate or acute, symmetrical; margin entire and somewhat undulate............**6. Q. kerangasensis**
Leaves ovate, minutely pubescent with golden hairs and not glaucous beneath, late-glabrescent; base rounded to obtuse, asymmetrical; margin entire or remotely serrulate in the apical half……………..…………...…....…………**7. Q. kinabaluensis**

Key to *Quercus* species

(for fruiting specimens with mature acorns and fully developed cupules)

1. Rim of fully developed cupule up to 0.5 mm thick; edge of lamellae free………....……2
Rim of fully developed cupule 1–4 mm thick; edge of lamellae tightly pressed to the cupule wall or rarely free……………………………………………………11

2. Cupule deeply cup-shaped, (1–)1.5–3(–3.5) cm deep, (1.5–)2–3(–4) cm diameter, covering 1/3–3/4 part of the acorn.......…………………………...............………...3
Cupule shallowly cup-shaped or flattish saucer-shaped, 0.5–1.5 cm deep, (0.7–)1–1.8(–3) cm diameter, covering 1/6–1/3 part of the acorn.......…………………………6

3. Cupule 2–3.5 cm deep, 2.5–4 cm diameter. Acorn 3–5 cm long, 2–3 cm diameter. Leaves pseudowhorled; petiole 3–5 mm long………………..........**13. Q. pseudoverticillata**
Cupule 1–2.5 cm deep and 1.5–3.2 cm diameter. Acorn 2–3(–3.5) cm long, 1.5–2(–3) cm diameter. Leaves spirally arranged; petiole 10–50 mm long……………………..4

4. Cupule rounded at base. Leaves sparsely tomentose with brownish stellate hairs and neither glaucous nor silvery beneath; margin remotely serrulate in the apical half......…………...………………………...…………………………...**4. Q. gaharuensis**
Cupule tapering towards the base. Leaves densely or sparsely tomentose with stellate hairs and glaucous or silvery beneath; margin entire………….……...…………………...5

5. Acorn conical, cylindrical or ovoid, 2–3 cm long, 1.5–2 cm diameter. Leaves densely

tomentose with silvery stellate hairs beneath..............................**1. Q. argentata**
Acorn obovoid to subglobose, *c.* 2 cm across. Leaves glaucous and sparsely tomentose with stellate hairs beneath..**11. Q. nivea**

6. Leaves 1.5–5.5 × 0.8–3.5 cm; petiole 1–6 mm long..7
Leaves (3–)10–15(–24) × (1–)3–5(–9) cm; petiole 10–35 mm long.............................8

7. Acorn densely tomentose. Leaves glabrous above, sparsely hairy below; margin entire, apex rounded, obtuse, or emarginate; lateral veins 4–5(–6) pairs..........**2. Q. chrysotricha**
Acorn glabrous. Leaves initially densely pubescent on both surfaces, late-glabrescent; margin remotely serrulate in the apical half, apex obtuse; lateral veins (5–)6–8 pairs...**10. Q. merrillii**

8. Leaves chartaceous to thin-coriaceous; base attenuate or acute..................................9
Leaves thick-coriaceous; base rounded or cordate..10

9. Cupule 1.7–3 cm diameter, base flat, lamellae 4–6. Acorn 2–2.5 cm diameter, base flat to concave. Leaves glaucous and sparsely pubescent with simple hairs below............ ....**15. Q. sumatrana**
Cupule 0.7–1 cm diameter, base rounded or attenuate, lamellae 7–8. Acorn 1–1.5 cm diameter, base rounded. Leaves not glaucous but sparsely, tomentose with silky stellate hairs beneath...**14. Q. subsericea**

10. Cupule 1.3–1.8 cm diameter, covering 1/4–1/3 part of the acorn. Acorn 1.5–2 × 1.3–1.5 cm, apex obtuse. Leaves (3–)6–10(–14) × (1–)2–4(–5.5) cm, densely tomentose with stellate hairs and not glaucous beneath; lateral veins 5–8 pairs..........**9. Q. lowii**
Cupule 2–2.3 cm diameter, covering 1/6–1/5 part of the acorn. Acorn 2–2.5 × 1.5–2.5 cm, apex depressed, rounded. Leaves (10–)16–18(–20) × (3.5–)4–8(–9) cm, glaucous and sparsely tomentose with stellate hairs beneath; lateral veins 10–12 pairs...**12. Q. percoriacea**

11. Cupule 1–2 cm diameter. Acorn 1–2(–3) × 0.8–1.5 cm...12
Cupule 2–4 cm diameter. Acorn 2–5.5 × 1–3 cm..13

12. Leaves elliptic or lanceolate, glabrous on both surfaces, glaucous below; base attenuate or acute, symmetrical, margin entire and somewhat undulate...........**6. Q. kerangasensis**
Leaves ovate, minutely pubescent with golden hairs and not glaucous below; base rounded to obtuse, asymmetrical; margin entire or remotely serrulate in the apical half...**7. Q. kinabaluensis**

13. Older leaves glabrous. Acorn up to 5.5 cm long..14
Older leaves densely hairy beneath. Acorn up to 3.2 cm long.....................................15

14. Leaf lateral veins 10–15 pairs, closely spaced, strongly prominent below; intercostal venation dense and prominent below...**17. Q. valdinervosa**
Leaf lateral veins 7–10 pairs, distantly spaced, only slightly prominent below; intercostal venation lax, obscure on both surfaces or only slightly prominent beneath..... ....**5. Q. gemelliflora**

15. Leaf lateral veins 15–20 pairs, closely spaced; intercostal venation densely scalariform, prominent beneath……………………………………………………..…………**8. Q. lineata**
    Leaf lateral veins 5–12 pairs, distantly spaced; intercostal venation fine, scalariform, reticulate, or subscalariform, obscure on both surfaces or distinct beneath and obscure above………………………………………………….……...………………………..16

16. Cupule cup-shaped, 1–1.5 × 2–3 cm; lamellae 10–12. Acorn with convex base. Leaves linear to narrowly lanceolate, (3–)7–10(–12) × 1–3 cm; intercostal venation fine, scalariform..…………………………………...…………………**16. Q. treubiana**
    Cupule saucer-shaped, 0.5–1.3 × 2–2.5 cm; lamellae 4–7. Acorn with truncate base. Leaves elliptic, oblong or lanceolate, (5–)8–13(–14) × (1–)1.5–4(–5) cm; intercostal venation subscalariform…………......…………...………………………..**3. Q. elmeri**

1. **Quercus argentata** Korth.

(Latin, *argentatus* = silvered; the silvery indumentum of the lower leaf surface)

Kruidk. (1844) 215; King *l.c.* 30; Gamble, J. As. Soc. Beng. 75, 2 (1915) 408, *p.p.*; Merrill, EB (1921) 211; Ridley *l.c.* 373, *p.p.*; Camus *l.c.* (1938) 311; Masamune, EPB (1942) 233; Soepadmo *l.c.* (1968) 384, *l.c.* (1972) 389; Cockburn *l.c.* (1972) 228, *l.c.* (1976) 118; Anderson *l.c.* 203; Whitmore, Tantra & Sutisna *l.c.*160; Turner, Gard. Bull. Sing. 47 (1995) 238; PROSEA *l.c.* 413; Argent *et al.* (eds.) *l.c.* 252. **Type:** *Korthals s.n.* (= *RHL Sheet No. 901309448*), Sumatra, Melintang Forest (holotype L; isotype K). **Synonyms:** *Cyclobalanopsis argentata* (Korth.) Oerst. *l.c.* 79; *Lithocarpus argentata* (Korth.) Merr., Contr. Arn. Arb. 8 (1934) 42; *Q. argentata* Korth. var. *concolor* Blume, Mus. Bot. Lugd.-Bat. 1 (1850) 299; *Q. pinanga* Blume *l.c.* (1850) 303; *Q. wilhelminae* Seemen, Bull. Dépt. Agr. Ind. Néerl. 1 (1906) 3; Merrill *l.c.* (1921) 216; Masamune *l.c.* 237.

Tree up to 40 m tall, 100 cm diameter; buttresses up to 1.5 m tall. **Bark** smooth, lenticellate, pale grey; inner bark brittle, pale brown. **Sapwood** yellowish. **Twigs** *glabrous*, *densely warty lenticellate*, greyish brown. Terminal buds ovoid to globose, 2–3 × 2–2.5 mm, stellate- or simple-tomentose, glabrescent. **Stipules** hairy, linear, 3–5 × 1–1.5 mm. **Leaves** *spirally arranged*, coriaceous, glabrous and glossy above, *tomentose with dense silvery stellate hairs below*, glabrescent; elliptic, oblong, lanceolate or oblanceolate, *(7–)10–18 (–25) × (2–)4–7(–9) cm*, *base attenuate*, *rounded or acute*, slightly asymmetrical, *margin entire*, revolute, *apex sharply acute to acuminate*, acumen 5–15 mm long; midrib prominent below, impressed above; *lateral veins (10–)12–18 pairs*, parallel, arching towards the leaf margin, forming an angle of 50–75º with the midrib; intercostal venation scalariform, obscure on both surfaces; *petiole* slender, black at the base, *10–40 mm long*, adaxially flat, grooved or sulcate, glabrous. **Male inflorescences** 5–10 cm long; bracts ovate, 1.5–2 × 0.5–1 mm, densely hairy. **Male flowers:** perianth 5-lobed, lobes *c.* 1 × 1.5 mm, connate at the base, hairy, stamens 6(–8), filaments hairy at the base. **Female inflorescences** many-flowered, 2–3 cm long, densely hairy; bracts and bracteoles linear, acute, 0.5–1 mm long. **Female flowers:** perianth 4–6-lobed, densely tomentose outside; ovary conical, 0.8–1 mm across, styles 3–4, pubescent with long golden-brown hairs at the base. **Cupules** *deeply cup-shaped*, *0.8–1.5 × 1.5–2 cm*, *tapering towards the base into a 0.3–0.5 cm long stalk*, *covering up to 1/3 of the acorn*; *rim thinner than 0.5 mm*; lamellae 8–12, *edge free*, denticulate. **Acorns** *conical*, *cylindrical*, *or ovoid*, *2–3 × 1.5–2 cm*, dark chocolate-brown when mature, glabrous; apex rounded or acute, base rounded.

Vernacular names. Sarawak—*empili* (Iban), *mempening* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Java, and Borneo. In Sabah and Sarawak scattered. Also in Kalimantan.

Ecology. In mixed dipterocarp forest to montane forest, at altitudes from sea level to 2500 m. Flowering in July–September; fruiting between October and May.

Use. Important source of *mempening* timber.

2. **Quercus chrysotricha** A. Camus

(Greek, *chrysotrichos* = golden-hairy; young twigs and inflorescences)

Chênes 3, Expl. Pl. 5 (1949) 50, *t.* 347, *ibid.* Text (1954) 1212; Soepadmo *l.c.* (1968) 397, *l.c.* (1972) 394; Anderson *l.c.* 203; Whitmore, Tantra & Sutisna *l.c.* 160. **Type:** *Richards 1885*, Borneo, Sarawak, Mt. Dulit, alt. *c.* 1300 m (holotype K; isotype L). **Synonym:** *Q. arbutifolia* (*non* Hickel & A. Camus) E.F. Warb., Kew Bull. (1936) 19.

Tree up to 20 m tall, 30 cm diameter; buttresses up to 1 m tall. **Bark** smooth, finely fissured or hoop-marked, brown mottled with greyish green patches. **Young twigs** initially densely covered with golden, woolly, simple hairs, late-glabrescent, lenticellate. Terminal buds ovoid to subglobose, *c.* 3 × 2 mm. **Stipules** linear, 8–10 × 1 mm, densely woolly rufous-tomentose with simple hairs. **Leaves** *spirally arranged*, thin-coriaceous, *glabrous above*, *sparsely pubescent below*; *ovate*, *elliptic or obovate*, *2.5–5.5 × 1.5–3.5 cm*, *base attenuate*, *acute or obtuse*, asymmetrical, *margin entire*, revolute, *apex rounded*, *obtuse or emarginate*; midrib raised below, flat or impressed above; *lateral veins 4–5(–6) pairs*, prominent below, flat above, parallel, arching towards the leaf margin, forming an angle of 60–70º with the midrib; intercostal venation fine, scalariform, obscure on both surfaces; *petiole (1–)2–3 mm long*, adaxially flat, *glabrous*. **Male inflorescences** up to 2 cm long, few-flowered, densely woolly pubescent with golden-brown hairs; bracts ovate, acute. **Male flowers** in dichasial clusters of 3 along the rachis; perianth 5-lobed; stamens 5, filaments glabrous. **Female inflorescences** up to 1 cm long, densely woolly pubescent with golden-brown hairs. **Female flowers:** perianth 5-lobed, densely woolly pubescent with golden-brown hairs; ovary conical, *c.* 1 × 0.6 mm, pubescent. **Cupules** *shallowly cup-shaped*, *1–1.5 cm across*, *covering 1/4–1/3 of the acorn*, base attenuate, pubescent on both surfaces; *rim up to 0.5 mm thick*; lamellae (4–)5(–7), *edge free*, denticulate. **Acorns** ovoid or conical, 1–1.5 cm across, chocolate-brown, *densely tomentose*, glabrescent; apex attenuate, acute, base rounded.

Vernacular name. Sarawak—*mempening* (Malay).

Distribution. Endemic to Borneo. In Sabah uncommon, in Sarawak scattered. Also in Kalimantan.

Ecology. In *kerangas* to lower montane forests, at 1200–1300 m altitude.

3. **Quercus elmeri** Merr.

(A.D.E. Elmer, 1870–1942, plant collector in Borneo and the Philippines)

Univ. Calif. Publ. Bot. 15 (1925) 43; Soepadmo *l.c.* (1968) 414, *l.c.* (1972) 398; Cockburn *l.c.* (1972) 229, *l.c.* (1976) 117; Anderson *l.c.* 203; Whitmore, Tantra & Sutisna *l.c.* 160; PROSEA *l.c.* 414; Turner *l.c.* 238. **Type:** *Elmer 21213*, Borneo, Sabah, Tawau district (holotype K; isotypes A, L, U).

Tree up to 40 m tall, 90 cm diameter; buttresses narrow, up to 3 m tall. **Bark** scaly, lenticellate, greyish brown; inner bark fibrous, reddish brown. **Sapwood** ochre. **Twigs** initially densely grey-brown pubescent, glabrescent, densely lenticellate. Terminal buds ovoid to subglobose, *c.* 3–5 mm across, densely tomentose. **Stipules** linear, acute, 5–7 × 1–2 mm, pubescent. **Leaves** *spirally arranged*, coriaceous, upper surface glabrous, *lower surface densely tomentose with greyish brown stellate hairs*, *late-glabrescent*; *elliptic*, *lanceolate to oblong*, *(5–)8–13(–14) × (1–)1.5–4(–5) cm*, *base attenuate*, *acute*, usually asymmetrical, *margin plane*, *remotely serrulate in the upper half*, *apex acuminate*, acumen 10–15 mm long; midrib prominent below, flat or slightly raised above; *lateral veins (6–) 8–12 pairs*, parallel, arching towards the leaf margin, *distantly spaced*, forming an angle of 60–70º with the midrib; *intercostal venation fine*, *subscalariform*, *distinct beneath*, *obscure above*; *petiole 10–30 mm long*, terete or flat on the adaxial side, densely pubescent, glabrescent. **Male inflorescences** 1–3 cm long; bracts ovate, acute, densely pubescent. **Male flowers:** perianth 3–4-lobed, densely pubescent; stamens 4–5, filaments pubescent at the base. **Female inflorescences** 3–4-flowered, 1–2 cm long, densely hairy; bracts ovate, acute. **Female flowers:** ovary conical, *c.* 1 × 0.8 mm, styles 3–4, recurved, 2–3 mm long, densely hairy at the base. **Cupules** *saucer-shaped*, *0.5–1.3 × 2–2.5 cm*, base truncate or rounded, covering 1/4–1/3 of the acorn, densely pubescent on both surfaces; *rim 1–2 mm thick*; *lamellae 4–7*, *edge tightly pressed towards cupule wall*, denticulate. **Acorns** densely sericeous, glabrescent, ovoid, conical to cylindrical, *2–3.2 × 1.5–2 cm*; apex depressed, rounded, *base truncate*.

Vernacular name. Sabah and Sarawak—*mempening* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, known from Bt. Kalong, Mt. Kinabalu, and Tawau. In Sarawak scattered. Also in Kalimantan.

Ecology. In lower montane forest, up to 1400 m altitude, on sandy loam and ultrabasic soils. Fruiting between September and April.

4. **Quercus gaharuensis** Soepadmo

(of G. Gaharu, Sarawak)

Gard. Bull. Sing. 21 (1966) 384, *l.c.* (1968) 389, *l.c.* (1972) 391; Cockburn *l.c.* (1972) 229; Anderson *l.c.* 203; Whitmore, Tantra & Sutisna *l.c.* 160; PROSEA *l.c.* 414; Turner *l.c.* 238; **Type:** *Anderson et al. S. 15534*, Borneo, Sarawak, Serian, lower slope of G. Gaharu, alt. *c.* 100 m (holotype K; isotypes BO, L, SAN, SAR).

Tree up to 30 m tall, 70 cm diameter; buttresses low, spreading, up to 0.7 m high. **Bark** smooth to slightly fissured, greyish brown. **Twigs** initially densely stellate-tomentose, glabrescent, lenticellate. Terminal buds ovoid to subglobose, *c.* 2 mm across. **Stipules** linear, acute, *c.* 5 × 1 mm. **Leaves** *spirally arranged*, thin-coriaceous, glabrous above, *not glaucous but sparsely tomentose with brownish stellate hairs below*; elliptic, lanceolate to oblong, *(5–)10–20(–23) × (2–)4–6 cm*, *base attenuate*, *acute* or rarely rounded, slightly asymmetrical, *margin plane*, *remotely serrulate in the apical half*, *apex acute*; midrib prominent and sparsely hairy with stellate hairs below; *lateral veins 8–15 pairs*, *distantly spaced*, parallel, arching towards the leaf margin, forming an angle of 45–60º with the midrib; *intercostal venation scalariform*, *distinct below*; *petiole 15–35 mm long*, adaxially flat, initially densely stellate-tomentose, glabrescent. **Male inflorescences** up to 3.5 cm long; bracts ovate, acute, 1–1.5 × 1 mm, caducous, hairy. **Male flowers** in dichasial clusters of 3 along the rachis; perianth 4–5-lobed, hairy; stamens 4–6, filaments hairy only at the base; pistillode replaced by a tuft of stiff hairs. **Female inflorescences** up to 1.5 cm long, 2–4-flowered; bracts ovate to linear, 1–2 × 0.5–1 mm, densely hairy. **Female flowers:** perianth 5–6-lobed; ovary conical, *c.* 0.8 × 1 mm, styles 3–4, cylindrical, 1–2 mm long, densely hairy at the base. **Cupules** *deeply cup-shaped*, *1–1.5 × 2.5–3 cm*, *covering 1/2–2/3 of the acorn*, *base rounded*, woolly pubescent on both sides, glabrescent; *rim up to 0.5 mm thick*; lamellae 6–8, *edge free*, slightly recurved and denticulate. **Acorns** ovoid to conical, *2–3 × 2–2.5 cm*, densely tomentose, glabrescent; apex obtuse, base flat or convex.

Vernacular name. Sabah and Sarawak—*mempening* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, uncommon, known only from Sipitang district. In Sarawak scattered. Possibly also in Kalimantan (record doubtful).

Ecology. In hill mixed dipterocarp forest to lower montane forest, up to 1400 m altitude. Fruiting between September and February.

5. **Quercus gemelliflora** Blume

(Latin, *gemellus* = twin-borne; *floris* = flower; the paired female flowers along the rachis)

Verh. Bat. Gen. K. & W. 9 (1823) 222; A. Camus *l.c.* (1938) 363; Backer & Bakhuizen *f.*, FJ 2 (1965) 5; Soepadmo *l.c.* (1968) 406, *l.c.* (1972) 395; Cockburn *l.c.* (1972) 229, *l.c.* (1976) 118; Whitmore, Tantra & Sutisna *l.c.* 161; PROSEA *l.c.* 414; Turner *l.c.* 238. **Type:** *Blume s.n.* (= *RHL Sheet No. 901310215*), Java, Mt. Salak (holotype L). **Synonyms:** *Q. turbinata* Blume, Bijdr. Fl. Ned. Ind. (1826) 523; *Q. merkusii* Endlicher, Gen. Pl., Suppl. 4, 2 (1847) 28; *Q. horsfieldii* Miq., Fl. Ned. Ind. 1, 1 (1856) 856; *Cyclobalanopsis gemelliflora* (Blume) Oerst. *l.c.* (1867) 77; *Cyclobalanopsis horsfieldii* (Miq.) Oerst. *l.c.* (1867) 78; *Cyclobalanopsis merkusii* (Endl.) Oerst. *l.c.* (1867) 79; *Q. lineata* Blume var. *merkusii* (Endl.) Wenzig, Jahrb. Kön. Bot. Gart. Berlin 4 (1886) 232; *Cyclobalanopsis turbinata* (Blume) Schottky, Bot. Jahrb. 47 (1912) 648; *Q. turbinata* Blume var. *crassilamellata* Gamble, J. As. Soc. Beng. 75, 2 (1915) 410; *Q. crassilamellata* (Gamble) A. Camus, Bull. Mus. Hist. Paris 2, 3 (1931) 689.

Tree up to 30 m tall, 60 cm diameter. **Bark** smooth or cracked, greyish brown; inner bark orange. **Sapwood** white. **Twigs** initially densely tomentose, glabrescent. Terminal buds ovoid to subglobose. **Stipules** linear, acute, 5–10 × 1–2 mm, hairy. **Leaves** *spirally* *arranged*, *thin-coriaceous*, *glabrous above*, *initially densely pubescent below*, *soon glabrescent*; obovate, elliptic, lanceolate, or oblanceolate, *(5–)9–15(–24) × (2–)4–6(–7) cm*, base attenuate or acute, often asymmetrical, *margin plane*, *serrulate in the apical half*, *apex acute*, *acuminate*, or caudate, acumen 5–15 mm long; midrib prominent below, flat or slightly raised above; *lateral veins 7–10 pairs*, *distantly spaced*, *slightly raised beneath*, parallel, arching towards the leaf margin, forming an angle of 45–60º with the midrib; *intercostal venation reticulate*, *lax*, *obscure on both surfaces or slightly distinct beneath*; *petiole (10–)20–30(–40) mm long*, adaxially flat, densely tomentose, glabrescent. **Male inflorescences** many-flowered, crowded mostly on young shoots, 3–6 cm long; bracts ovate, 2–3 × 1–1.5 mm, hairy. **Male flowers** solitary or in dichasial clusters of 3 along the rachis; perianth 3–6-lobed, lobes *c.* 1 mm across, densely hairy; stamens 3–6. **Female inflorescences** 2–7-flowered, 2–4 cm long, densely hairy; bracts ovate, acute, 1–2 × 1 mm. **Female flowers** usually in pairs along the rachis; perianth 4–6-lobed, densely hairy; staminodes 0–6; ovary ovoid, *c.* 1 mm across, styles 4–6, 1–2 mm long, hairy at the base. **Cupules** *usually in pairs along the rachis*, cup-shaped, *1.5–2.5 × 1.7–2.5 cm*, covering 1/3–1/2 of the acorn, base attenuate to rounded, densely woolly pubescent inside, densely tomentose with short brown hairs outside; *rim c. 2 mm thick*; lamellae 6–8, *edge tightly pressed towards cupule wall*, denticulate. **Acorns** ovoid, conical or cylindrical, *2–5.5 × 2–2.5 cm*, densely tomentose, glabrescent; apex obtuse, base rounded.

Vernacular name. Sabah and Sarawak—*mempening* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and Java. In Sabah and Sarawak scattered. Also in Kalimantan.

Ecology. In hill mixed dipterocarp forest to montane forest, up to 2600 m altitude, usually near streams, on red sandy clay overlying sandstone or granite or on ultrabasic soils. Flowering and fruiting the whole year round.

6. **Quercus kerangasensis** Soepadmo

(Iban, *kerangas* = a type of soil which is not suitable for cultivating rice; referring to its natural habitat)

Gard. Bull. Sing. 21 (1966) 399, *l.c.* (1968) 396, *l.c.* (1972) 395; Anderson *l.c.* 204; Whitmore, Tantra & Sutisna *l.c.* 161; Coode *et al.* (eds.) *l.c.* 127. **Type:** *Brunig S. 1065*, Borneo, Brunei, Seria, Badas FR (holotype K; isotypes L, SAR).

Tree up to 30 m tall, 50 cm diameter; buttresses low. **Bark** greyish, smooth or lenticellate. **Twigs** initially densely greyish brown pubescent with stiff hairs, glabrescent, densely warty lenticellate. Terminal buds ovoid to subglobose, 3–6 × 2–4 mm, densely pubescent. **Stipules** linear, acute, 2–3 × 0.5–1 mm, densely pubescent, glabrescent, caducous. **Leaves** *spirally arranged*, coriaceous, *glabrous on both surfaces*, *glaucous below*; *elliptic or lanceolate*, *(4–)5–10(–12) × 2–4(–5) cm*, *base attenuate or acute*, *symmetrical*, *margin entire and somewhat undulate*, *apex acute to acuminate*, acumen 5–15 mm long; midrib prominent below, flattish above; lateral veins fine on both surfaces, 7–10 pairs, subparallel, arching towards the leaf margin, forming an angle of 60–65º with the midrib; *intercostal venation* *fine*, *scalariform*, *obscure on both surfaces*; *petiole* slender, *10–12 mm long*, *flat on the adaxial side*. **Male inflorescences** 1–2 cm long, few-flowered; bracts ovate, acute, *c.* 1 mm across, membranous, pubescent outside. **Male flowers** in dichasial clusters of 3 along the densely tomentose rachis; perianth 5–6-lobed, membranous, densely pubescent; stamens 5–6, filaments up to 2 mm long. **Female inflorescences** unknown. **Cupules** cup-shaped, obconical, *0.8–1.2 × 1.5–2 cm*, covering up to 1/3 of the acorn, base attenuate, densely brownish tomentose on both sides; *rim 1–1.5 mm thick*; lamellae 5–8, *edge tightly pressed towards cupule wall*, denticulate or smooth. **Acorns** ovoid, conical or cylindrical, densely sericeous with short brown hairs, glabrescent, shining, chocolate-brown, *2–3 × 1.2–1.5 cm*; apex rounded or acute, base strongly convex.

Vernacular names. Sabah—*mempening* (Malay). Sarawak—*empenit* (Iban), *mempening* (Malay).

Distribution. Endemic to Borneo. No record for Sabah. In Sarawak recorded only from Ulu Baram in Marudi district. Also in Brunei. The correct identity of *Quercus* "*kerangensis*" as reported for C Kalimantan (Argent *et al.* (eds.) *l.c.* 255) is doubtful.

Ecology. In lowland *kerangas* forest, up to 200 m altitude. Flowering in June; fruiting in September.

7. **Quercus kinabaluensis** Soepadmo

(of Mt. Kinabalu, Sabah)

Gard. Bull. Sing. 21 (1968) 401, *l.c.* (1972) 395; Anderson *l.c.* 204; Cockburn *l.c.* (1976) 117; Whitmore, Tantra & Sutisna *l.c.* 161. **Type:** *Chew & Corner RSNB 7148*, Borneo, Sabah, Mt. Kinabalu, Mentaki Ridges (holotype K; isotype L).

Tree up to 35 m tall, 70 cm diameter. **Bark** greyish, smooth or slightly cracked; inner bark light brown. **Sapwood** yellowish. **Twigs** initially densely brownish pubescent with stiff simple hairs, glabrescent, sparsely lenticellate. Terminal buds ovoid to subglobose, 4–10 × 3–4 mm. **Stipules** linear, acute, 5–10 × 0.5–1 mm, caducous. **Leaves** *spirally arranged*, thick-coriaceous, *glabrous above*, *minutely pubescent with golden hairs beneath*, *late-glabrescent*; *ovate*, *5–10 × 2–4 cm*, *base rounded to obtuse*, *often asymmetrical*, *margin entire or remotely serrulate in the apical half*, slightly revolute, *apex acute to acuminate*, acumen up to 15 mm long; midrib slightly prominent below, flat above; lateral veins 6–9 pairs, parallel, arching towards the leaf margin, forming an angle of 45–60º with the midrib; *intercostal venation fine*, *scalariform*, *obscure on both surfaces*; *petiole 10–15 mm long*, *adaxially flat*, densely brownish pubescent, glabrescent. **Male inflorescences** densely yellowish brown pubescent, 5–10 cm long; bracts ovate, acute, 2–3 × 1–2 mm, membranous, densely pubescent outside. **Male flowers** in dichasial clusters of threes or solitary along the rachis; perianth 4–7-lobed, pubescent outside, glabrescent; stamens 4–7, filaments *c.* 2 mm long. **Female inflorescences** 1–3 cm long, 1–3-flowered, densely hairy. **Female flowers:** perianth 4–6-lobed, densely hairy; ovary ovoid, *c.* 1 × 0.6 mm, styles 3–5, hairy at the base, recurved, 2–3 mm long. **Cupules** obconical, cup-shaped, *1–2 × 1–2 cm*, covering up to 1/2 of the acorn, base attenuate, pubescent on both surfaces; *rim c. 1 mm thick*; lamellae 6–8, *edge tightly pressed towards cupule wall*, smooth to denticulate. **Acorns** ovoid to conical, densely brown tomentose, glabrescent, *1–1.5 × 0.8–1 cm*; apex rounded or attenuate, base convex.

Vernacular names. Sabah—*mempening* (Malay). Sarawak—*empeli* (Iban).

Distribution. Endemic to Borneo, uncommon. In Sabah only recorded for Mt. Kinabalu area, and in Sarawak from G. Pueh in Lundu district and G. Murud in Limbang district. Not known in Brunei and Kalimantan.

Ecology. In hill mixed dipterocarp forest to montane forest, at 600–2600 m altitude, mainly on ultrabasic soils. Flowering in February; fruiting between March and May.

8. **Quercus lineata** Blume

(Latin, *lineatus* = marked by parallel, fine lines; referring to the closely spaced, parallel lateral veins)

Bijdr. Fl. Ned. Ind. (1825) 523; A. Camus *l.c.* (1938) 207; Backer & Bakhuizen *f. l.c.* 5; Soepadmo *l.c.* (1968) 408, *l.c.* (1972) 396; Cockburn *l.c.* (1972) 230, *l.c.* (1976) 117; Whitmore, Tantra & Sutisna *l.c.* 161; Turner *l.c.* 238; PROSEA *l.c.* 415. **Type:** *Blume s.n.* (= *RHL Sheet No. 90131161*), Java (holotype L; isotypes A, BO, K). **Synonyms:** *Q. polyneura* Miq., Pl. Jungh. 1 (1851) 11; *Q. lineata* Blume var. *heterochroa* Miq. *l.c.* (1856) 855; *Q. oxyrhyncha* Miq. *l.c.* (1860) 347; *Cyclobalanopsis lineata* (Blume) Oerst. *l.c.* 78; *Q. lineata* Blume var. *typica* King, Ann. Roy. Bot. Gard. Calc. 2 (1889) 33; *Q. lineata* Blume var. *oxyrhyncha* (Miq.) Seemen *l.c.* 4; *Q. hendersoniana* A. Camus, Bull. Mus. Paris, Ser. I, 4 (1932) 123.

Tree up to 30 m tall, 60 cm diameter. **Bark** smooth, greyish; inner bark fibrous, reddish brown. **Sapwood** pale, white. **Young twigs** and buds densely pubescent with golden brown hairs, glabrescent, lenticellate. Terminal buds ovoid to subglobose, 1.5–2.5 mm across. **Stipules** linear, acute, 10–15 × 1–2 mm, densely pubescent, caducous. **Leaves** *spirally arranged*, thin-coriaceous, glabrous to sparsely pubescent above, *densely greyish brown tomentose with appressed simple hairs below*; elliptic or lanceolate, *(5–)15–20(–23) × 2–6 cm*, base attenuate, acute, sometimes asymmetrical, *margin plane*, *remotely serrulate in the apical half*, *apex acuminate*, acumen 10–15 mm long; midrib prominent below, flat or slightly raised above; *lateral veins 15–20 pairs*, *closely spaced*, straight and parallel towards the leaf margin, forming an angle of 45–60º with the midrib; *intercostal venation densely scalariform*, *distinct below*; *petiole 15–25 mm long*, adaxially flat or shallowly furrowed, sparsely tomentose. **Male inflorescences** 5–10 cm long; bracts ovate, acute, 2–3 × 2 mm, membranous, densely sericeous outside, glabrescent. **Male flowers** solitary or in dichasial clusters of three along the rachis; perianth 5–6-lobed, densely tomentose outside; stamens 6(–8), filaments up to 1 mm long, glabrous; pistillode replaced by a clusters of stiff, simple hairs. **Female inflorescences** 5–6-flowered, 1.5–2 cm long, densely hairy; bracts ovate, acute, 2 × 1 mm, densely tomentose. **Female flowers:** perianth 5–6-lobed, hairy; ovary conical, *c.* 1.3 × 1 mm, styles 3, 1–3 mm long, recurved, sparsely pubescent at the base. **Cupules** cup-shaped, obconical, *1–1.2 × 2–2.5 cm*, covering *c.* 1/3 of the acorn, base attenuate or rounded, pubescent outside; *rim 1–2 mm thick*; lamellae 5–10, *edge tightly pressed towards cupule wall*, denticulate. **Acorns** ovoid, subglobose to cylindrical, *2–3 × 1–3 cm*, densely tomentose, base rounded; apex attenuate to rounded.

Vernacular name. Sabah and Sarawak—*mempening* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Java, and Borneo. In Sabah known mainly from Mt. Kinabalu, and in Sarawak from G. Pueh and G. Berumput in Lundu district.

Ecology. In lower to upper montane forest, at 1000–2000 m altitude, on yellow sandy or ultrabasic soils. Flowering in April to May; fruiting between August and April.

9. **Quercus lowii** King Fig. 15.

(Sir Hugh Low, 1824–1905; officer of the British East India Company; plant collector)

Ann. Roy. Bot. Gard. Calc. 2 (1889) 28; Merrill *l.c.* (1921) 214; A. Camus *l.c.* (1938) 366; Masamune *l.c.* 235; Soepadmo *l.c.* (1968) 394, *l.c.* (1972) 393; Cockburn *l.c.* (1976) 117; Whitmore, Tantra & Sutisna *l.c.* 161. **Type:** *Low s.n.*, Borneo, Sabah, Mt. Kinabalu (holotype CAL, *n.v.*). **Synonym:** *Cyclobalanopsis lowii* (King) Schottky, Bot. Jahrb. 47 (1912) 653.

Tree up to 20 m tall, 40 cm diameter, occasionally with short buttresses. **Bark** rough; inner bark pinkish to brownish, fibrous. **Sapwood** pale ochre to yellow. **Twigs** dark grey, shallowly fissured, initially densely pubescent with stellate hairs, late-glabrescent, lenticellate. Terminal buds ovoid to subglobose, densely tomentose. **Stipules** linear, acute, 2–4 × 0.3–0.5 mm. **Leaves** *spirally arranged*, *thick-coriaceous*, *upper surface glabrous* and glossy or dull with sparse stellate hairs on the midrib, *lower surface densely tomentose with brownish stellate hairs*, *late-glabrescent*; *ovate to elliptic*, *(3–)6–10(–14) × (1–)2–4(–5.5) cm*, *base rounded or cordate*, sometimes asymmetrical, margin entire or remotely serrulate in the upper half, *apex acute to acuminate*, acumen (5–)10–15(–20) mm long; midrib prominent or flattish below, impressed above; *lateral veins 5–8 pairs*, parallel, arching towards leaf margin, forming an angle of 50–60° with the midrib; *intercostal venation fine*, *reticulate*, *distinct above*, *obscure below*; *petiole 10–25 mm long*, *adaxially grooved*, densely tomentose with simple and stellate hairs, glabrescent. **Male inflorescences** slender, 5–10 cm long, densely tomentose with stellate hairs, unbranched or rarely branched; bracts ovate, acute, densely hairy, 1–2 × 0.5 mm. **Male flowers** solitary or in dichasial clusters of three along the rachis; perianth 5–6-lobed, densely tomentose, glabrescent; stamens 4–6, filaments up to 1 mm long; pistillode replaced by fine woolly hairs. **Female inflorescences** 2–5-flowered, 1–2 cm long, densely hairy; bracts ovate, acute, *c.* 1 mm across. **Female flowers:** perianth (4–)5–6(–7)-lobed, densely hairy; ovary conical, *c.* 1 × 0.7 mm, styles 3–6, hairy at the base. **Cupules** *shallowly cup-shaped*, *0.8–1 × 1.3–1.8 cm*, *covering 1/4–1/3 of the acorn*, base rounded, densely tomentose on both sides; *rim less than 0.5 mm thick*; lamellae 4–5, *edge free*, denticulate. **Acorns** conical, ovoid to cylindrical, *1.5–2 × 1.3–1.5 cm*, densely tomentose with stellate hairs, glabrescent; *apex obtuse*, base convex.

Vernacular name. Sabah and Sarawak—*mempening* (Malay).

Distribution. Endemic to Borneo; so far known from Sabah (mainly on Mt. Kinabalu), Sarawak and Kalimantan (Mt. Lianggagang).

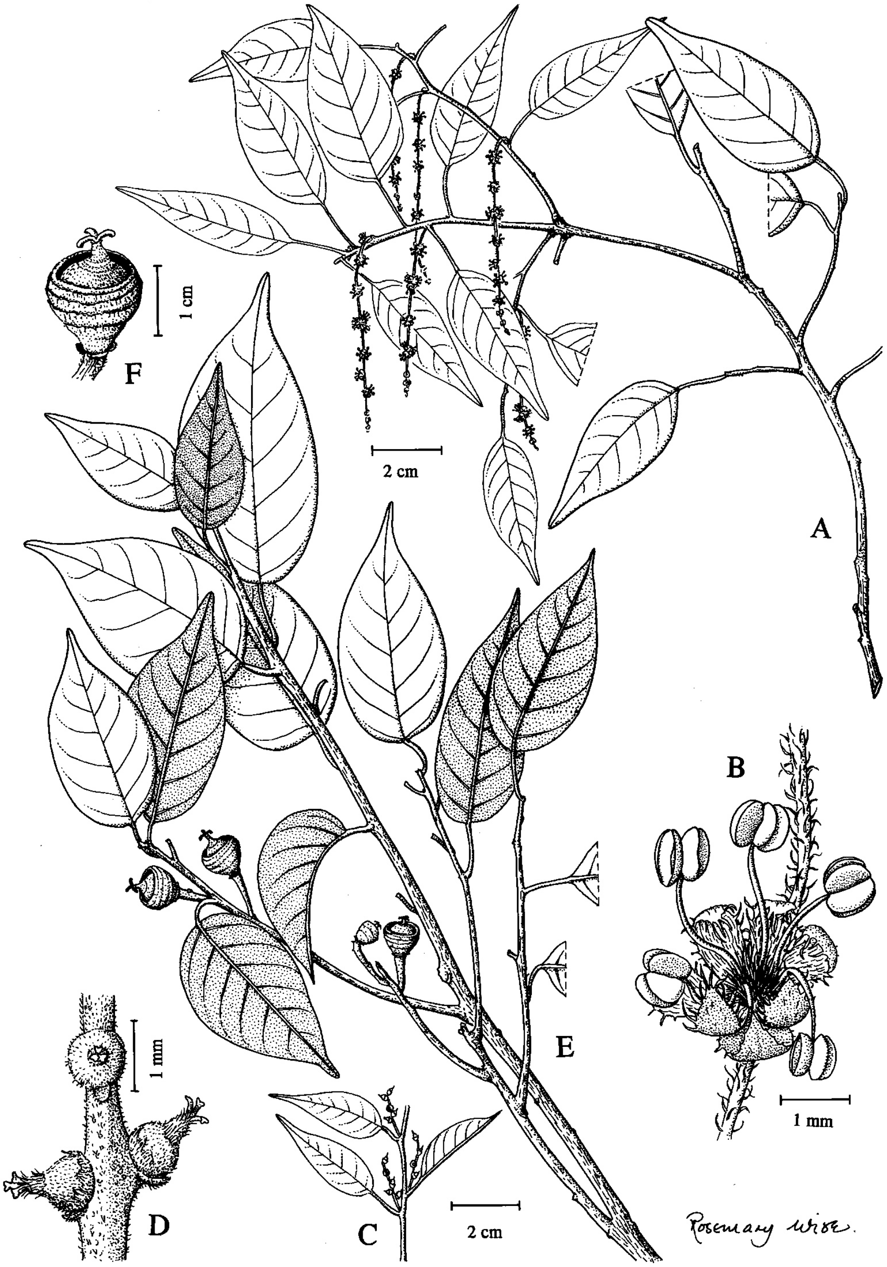

Fig. 15. *Quercus lowii.* A, leafy flowering (male) twig; B, male flower; C, leafy flowering (female) twig; D, female flowers; E, leafy fruiting twig; F, cupule and young acorn. (A–B from *SAN 24106*, C–D from *SAN 38534*, E from *S. 34855*, F from *SAN 34504*.)

Ecology. In hill mixed dipterocarp forest to montane forest, up to 2500 m altitude, mainly on blackish ultrabasic soils. Flowering in June–July; fruiting between August and March.

Use. The timber is source of medium hardwood in Sabah.

10. **Quercus merrillii** Seemen

(E.D. Merrill, American botanist; 1919–1923 Director of the Bureau of Science in Manila, 1930–1935 Director of the New York Botanical Garden, U.S.A.)

Fedde Rep. 5 (1908) 21; Merrill, Philip. J. Sc. 3 (1908) Bot. 329; Soepadmo *l.c.* (1968) 397, *l.c.* (1972) 394; Cockburn *l.c.* (1976) 117; Anderson *l.c.* 204; Whitmore, Tantra & Sutisna *l.c.* 161. **Type:** *Foxworthy 566*, the Philippines, Palawan (holotype K). **Synonym:** *Cyclobalanopsis merrillii* (Seemen) Schottky, Bot. Jahrb. 47 (1912) 649.

Tree up to 10 m tall, 20 cm diameter. **Bark** slightly flaky, greyish brown. **Twigs** densely hairy with brownish hairs, glabrescent, lenticellate. Terminal buds ovoid or conical *c.* 3 × 2 mm. **Stipules** linear, acute, 0.5–1 × 0.1 mm, caducous. **Leaves** *spirally arranged*, thin-coriaceous, *initially densely pubescent on both surfaces*, *late-glabrescent*; obovate, ovate, or elliptic, *(1.5–)3–4(–5.5) × 0.8–2.5 cm*, *base attenuate* or *acute*, *margin remotely serrulate in the apical half*, *apex obtuse*; midrib prominent beneath, impressed to flat above; *lateral veins (5–)6–8 pairs*, parallel, arching towards the leaf margin, forming an angle of 50–60° with the midrib; intercostal venation fine, scalariform, obscure on both surfaces; *petiole 2–6 mm long*, adaxially flat, *densely tomentose*, glabrescent. **Male inflorescences** 3–4 cm long, densely woolly pubescent with golden brown hairs; bracts ovate. **Male flowers** solitary along the rachis; perianth 5-lobed, pubescent with soft long simple golden hairs; stamens 6–7, filament glabrous. **Female inflorescences** 1–4-flowered, 1–2 cm long, densely hairy; bracts ovate, acute. **Female flowers** densely hairy; perianth 4–5-lobed; ovary conical, *c.* 1 × 0.7 mm, styles 4, recurved, densely pubescent at the base. **Cupules** *shallowly cup-shaped*, *0.7–1.4 × 1.5–1.8 cm*, *covering 1/4–1/3 of the acorn*, pubescent on both surfaces; *rim up to 0.5 mm thick*; lamellae 4–8, *edge free*, finely denticulate. **Acorns** ovoid, conical or cylindrical, 2–2.5(–3) × 1–1.5 cm, *glabrous*; apex acute, base rounded.

Vernacular names. Sabah—*mempening* (Malay). Sarawak—*empili* (Iban).

Distribution. Borneo and Palawan in the Philippines. In Sabah and Sarawak uncommon. Not known in Brunei and Kalimantan.

Ecology. In hill mixed dipterocarp forest, up to 500 m altitude. Fruiting between April and August.

11. **Quercus nivea** King

(Latin, *niveus* = snow white; the leaf undersurface)

Ann. Roy. Bot. Gard. Calc. 2 (1889) 31; Merrill *l.c.* (1921) 214; A. Camus *l.c.* (1938) 313; Soepadmo *l.c.* (1968) 387, *l.c.* (1972) 391; Cockburn *l.c.* (1972) 230; Anderson *l.c.* 204; Whitmore, Tantra & Sutisna *l.c.* 161. **Lectotype** (Soepadmo, 1968)**:** *Beccari PB 2551*, Borneo, Sarawak (FI).

Tree up to 25 m tall, 40 cm diameter; buttresses up to 2 m tall. **Bark** pale grey, rough; inner bark dull brown, fibrous. **Sapwood** creamy or white. **Twigs** *initially densely tomentose with brownish stellate hairs*, *subglabrescent*, *shallowly fissured*, *sparsely lenticellate*. Terminal buds ovoid to ellipsoid, 3–4 × 2–3 mm. **Stipules** linear, acute, 2–3 × 0.5–1 mm, tomentose with stellate hairs, caducous. **Leaves** *spirally arranged*, thick-coriaceous, glabrous and glossy above, *sparsely tomentose with minute stellate hairs and glaucous below*; elliptic to oblong, *(6–)10–15(–20) × (2.5–)3–5(–8) cm*, *base rounded or obtuse*, sometimes asymmetrical, *margin entire*, *revolute*, *apex acute*, *acuminate or caudate*; midrib impressed or flat above, strongly raised below; *lateral veins (6–)7–10(–12) pairs*, parallel, faint or flattish on both surfaces, arching towards the leaf margin, forming an angle of 60–70° with the midrib; intercostal venation scalariform, obscure on both surfaces; *petiole* slender, *25–45 mm long*, adaxially deeply sulcate towards leaf blade, densely tomentose with stellate hairs, glabrescent. **Male inflorescences** (5–)10–15(–20) cm long, densely tomentose with stellate hairs. **Male flowers** in dichasial clusters of three or solitary along the rachis; perianth 4–6-lobed; stamens 4–6, filaments 1–2 mm long, hairy at the base. **Female inflorescences:** bracts ovate, acute, densely hairy with short stiff hairs, caducous. **Female flowers:** perianth 5–6-lobed, densely tomentose with stellate hairs; staminodes rather well-developed; ovary subglobose, *c.* 1 mm across, styles 3–4, 1–1.2 mm long, sparsely tomentose with stellate hairs at the base. **Cupules** *deeply cup-shaped*, *tapering towards the base*, *1–1.5 × 3–3.2 cm*, *covering 1/3–1/2 of the acorn*, woolly pubescent inside, glabrescent outside; *rim up to 0.5 mm thick*; lamellae 4–7, *edge free*, undulate. **Acorns** *obovoid to subglobose*, *c. 2 cm across*, glabrous; apex depressed, base convex.

Vernacular name. Sabah and Sarawak—*mempening* (Malay).

Distribution. Peninsular Malaysia and Borneo, uncommon. In Borneo, known only from G. Gaharu in Simunjan district and G. Pueh in Lundu district, Sarawak.

Ecology. In hill mixed dipterocarp and *kerangas* forests, up to 1000 m altitude. Flowering in January to February; fruiting in June to July.

12. **Quercus percoriacea** Soepadmo

(Latin, *per-* = exceedingly, *coriaceous* = leathery; the thick-leathery leaves)

Gard. Bull. Sing. 21 (1966) 382, *l.c.* (1968) 396, *l.c.* (1972) 394; Anderson *l.c.* 204; Whitmore, Tantra & Sutisna *l.c.* 161; Coode *et al.* (eds.) *l.c.* 127. **Type:** *Anderson S. 20226*, Borneo, Sarawak, Bario, Ulu Baram (holotype K; isotypes L, SAN, SAR, SING).

Tree up to 30 m tall, 50 cm diameter; buttresses up to 2 m tall. **Bark** smooth, grey, hoop-marked. **Twigs** grey, glabrous, lenticellate. Terminal buds ovoid to subglobose, *c.* 3 × 2 mm, densely tomentose. **Leaves** *spirally arranged*, *thick-coriaceous*, glabrous and shining above, *pale glaucous and sparsely tomentose with fine stellate hairs to glabrescent below*; ovate or elliptic, *(10–)16–18(–20) × (3.5–)4–8(–9) cm*, *base rounded*, *margin entire*, *plane and undulate in the lower half*, *distantly serrate or crenate in the upper half*, *apex acuminate*, acumen 10–15 mm long; midrib prominently raised beneath, flattish above; *lateral veins* prominent below, impressed above, *10–12 pairs*, *distantly spaced*, parallel, arching towards the leaf margin, forming an angle of 40–60° with the midrib; intercostal venation dense, fine, scalariform, obscure above, prominent below; *petiole 20–35 mm*, slightly grooved or flat on the adaxial side, glabrous. **Male inflorescences** 5–6 cm long, many-flowered, densely tomentose with stellate hairs. **Male flowers** in dichasial clusters of 3–4 along the rachis; perianth 5–6-lobed, hairy; stamen 5–6, filament 1.5–2 mm long. **Female inflorescences** 2–4-flowered, up to 1 cm long, densely covered with brown hairs. **Female flowers:** perianth 4–5-lobed, densely hairy; ovary conical, *c.* 0.8 × 1.2 mm, styles 3–4. **Cupules** *shallowly cup-shaped*, *0.7–1 × 2–2.3 cm*, *covering 1/6–1/5 of the acorn*, base rounded, densely sericeous on both surfaces; *rim up to 0.5 mm thick*; lamellae 6–8, *edge free*, denticulate or smooth. **Acorns** densely sericeous, ovoid to subglobose, *2–2.5 × 1.5–2.5 cm*; *apex depressed*, *rounded*, base convex.

Vernacular names. Sarawak—*berangan bu*, *empili* (Iban), *mempening* (Malay), *palan baboi* (Kenyah), *salad* (Murut).

Distribution. Endemic to Borneo. In Sarawak scattered. Not yet reported for Sabah. Also in Brunei.

Ecology. In primary *kerangas* forest on plateau sands, at 1000–1200 m altitude. Fruiting in June to July.

13. **Quercus pseudoverticillata** Soepadmo Fig. 16.

(Latin, *pseudo-* = somewhat, *verticillatus* = whorled; the pseudowhorled leaves)

Gard. Bull. Sing. 21 (1966) 380, *l.c.* (1968) 384, *l.c.* (1972) 389; Cockburn *l.c.* (1976) 116; Whitmore, Tantra & Sutisna *l.c.* 161. **Type:** *Chew & Corner RSNB. 4434*, Borneo, Sabah, Mt. Kinabalu, Bembangan R., alt. *c.* 1600 m (holotype K; isotype L).

Tree up to 30 m tall, 90 cm diameter; buttresses up to 2 m high. **Bark** brown, scaly; inner bark pink. **Sapwood** pink. **Twigs** glabrous, lenticellate. Terminal buds ovoid to subglobose, 2–3 × 2 mm. **Leaves** *pseudowhorled*, thick-coriaceous, glabrous above, sparsely tomentose below; *oblanceolate*, elliptic or lanceolate, *(6–)10–12(–17) × (3–)4–4.5(–6.5) cm*, *base rounded, cordate to auriculate*, margin entire, revolute, *apex rounded to obtuse*; midrib flat to slightly sunken above, strongly raised beneath; *lateral veins 8–15 pairs*, parallel, arching towards the leaf margin, forming an angle of 30–45° with the midrib; intercostal venation fine, scalariform, obscure and minutely pubescent on both surfaces, *petiole 3–5 mm long*, adaxially flat, tomentose, glabrescent. **Inflorescences** and **flowers** unknown. **Cupules** *deeply cup-shaped*, *2–3.5 × 2–4 cm*, *covering 1/3–1/2 of the acorn*; base attenuate, densely pubescent inside, glabrescent outside; *rim up to 0.5 mm thick*; lamellae 10–12, *edge free*, dentate or undulate. **Acorns** ovoid to cylindrical, densely sericeous, *3–5 × 2–3 cm*; apex rounded or depressed, base flat to convex.

Vernacular name. Sabah—*mempening* (Malay).

Distribution. Endemic to Borneo. So far only known from Sabah (Mt. Kinabalu) and Kalimantan.

Ecology. In lower montane forest, up to 1600 m altitude. Fruiting between October and February.

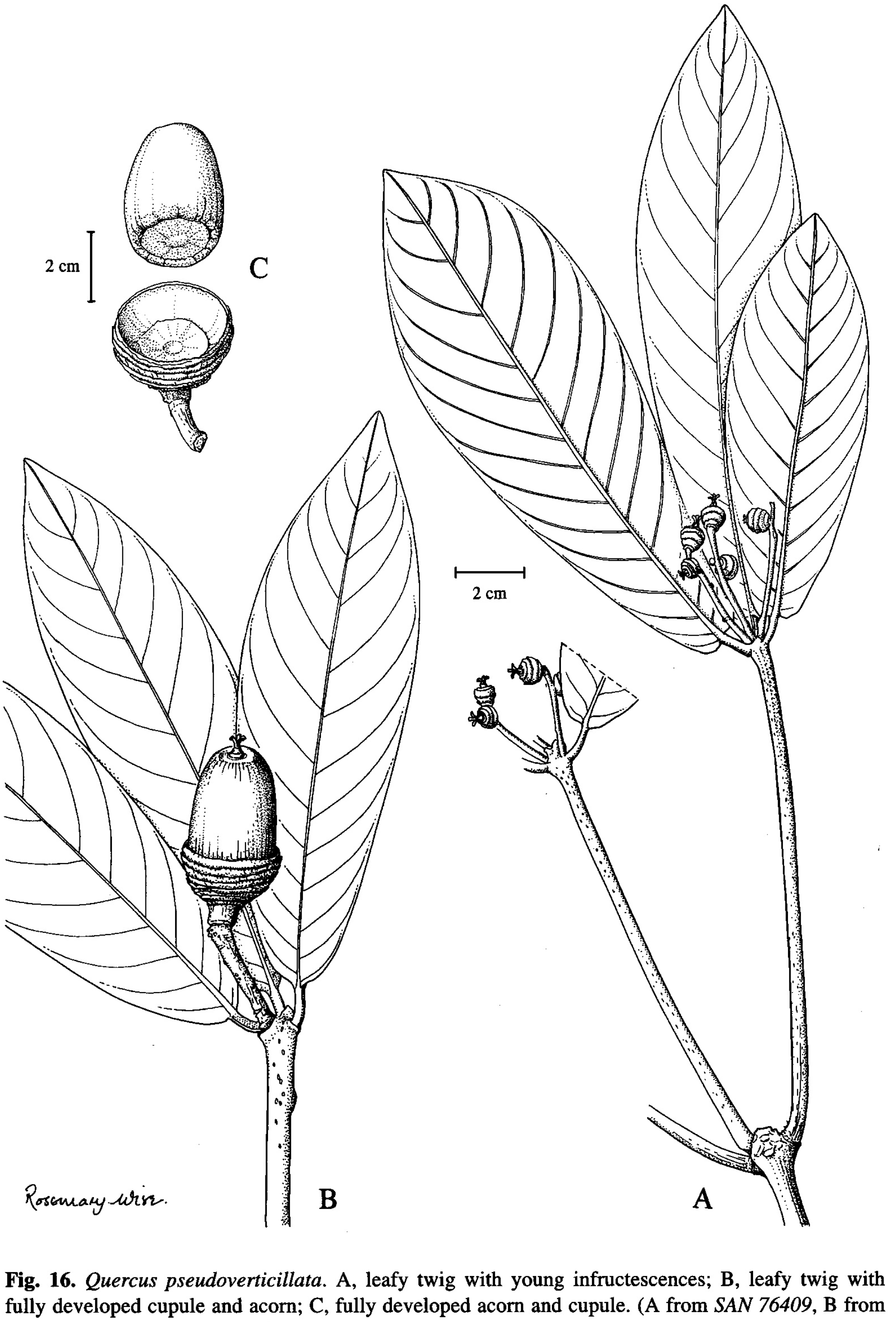

Fig. 16. *Quercus pseudoverticillata.* A, leafy twig with young infructescences; B, leafy twig with fully developed cupule and acorn; C, fully developed acorn and cupule. (A from *SAN 76409*, B from *SAN 38082*, C from *SAN 38651*.)

14. **Quercus subsericea** A. Camus

(Latin, *sub-* = almost, *sericeus*=silky; referring to the indumentum of the leaf undersurface)

Bull. Soc. Bot. France 80 (1933) 354, *l.c.* (1938) 366; Soepadmo *l.c.* (1968) 392, *l.c.* (1972) 393; Cockburn *l.c.* (1972) 231, *l.c.* (1976) 116; Anderson *l.c.* 204; Whitmore, Tantra & Sutisna *l.c.* 162; Turner *l.c.* 238; Coode *et al.* (eds.) *l.c.* 127; Argent *et al.* (eds.) *l.c.* 255. **Type:** *Teijsmann HB. 21080*, Sumatra, Bangka (holotype BO; isotype K). **Synonyms:** *Q. seriacea* (*non* Willd. 1805) Scheffer, Nat. Tijdschr. Ned. Ind. 31 (1870) 361, King *l.c.* 63, Merrill *l.c.* (1921) 215; *Cyclobalanopsis seriacea* (Scheff.) Schottky *l.c.* 656; *Synaedrys seriacea* (Scheff.) Koidzumi, Bot. Mag. Tokyo 30 (1916) 192.

Tree up to 20 m tall, 40 cm diameter; buttresses up to 2 m tall. **Bark** greyish brown, finely fissured to scaly, lenticellate; inner bark fibrous, brownish. **Sapwood** white. **Twigs** initially densely tomentose with stiff simple and stellate hairs, glabrescent, minutely lenticellate. Terminal buds ovoid to subglobose, 3–4 × 2–3 mm, densely tomentose. **Stipules** linear, acute, 5–7 × 1–2 mm. **Leaves** *spirally arranged*, *thin-coriaceous*, glabrous and shining above, *not glaucous but sparsely silky tomentose with stellate hairs to glabrous below*; *elliptic to lanceolate*, rarely ovate, *(4–)5–10(–16) × (2–)3–4(–5) cm*, *base attenuate or acute*, margin entire or occasionally remotely serrulate towards apex, faintly revolute, *apex acute or acuminate*, acumen 5–15 mm long; midrib prominent below, impressed or sunken above; lateral veins 6–12 pairs, slightly prominent to flattish below, impressed above, parallel, arching towards the leaf margin, forming an angle of 45–60º with the midrib; *intercostal venation fine*, *reticulate*, *obscure on both surfaces*; *petiole 10–25 mm long*, *adaxially grooved*, glabrous. **Male inflorescences** with many well-spaced flowers, 4–6 cm long; bracts ovate, acute, hairy, *c.* 1–2 × 1 mm. **Male flowers** solitary or in dichasial clusters of three along the rachis; perianth 5–6-lobed, tomentose; stamens 5–7, filaments slender, 1–1.5 mm long. **Female inflorescences** 2–5-flowered, 1–2 cm long, densely tomentose; bracts ovate, acute, tomentose outside. **Female flowers:** perianth 5–6-lobed, densely tomentose; ovary ovoid to globose, *c.* 0.5 mm across, styles 3–4, tomentose at base. **Cupules** *shallowly cup-shaped*, *0.5–1.2 × 0.7–1 cm*, *base rounded or attenuate*, *covering 1/4–1/3 of the acorn*; *rim up to 0.5 mm thick*; *lamellae 7–8*, densely tomentose, *edge free*, denticulate. **Acorns** ovoid, conical to subglobose, *1–2 × 1–1.5 cm*, densely sericeous; apex acute, depressed or rounded, *base rounded.*

Vernacular name. Sabah and Sarawak—*mempening* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and W Java. In Sabah and Sarawak scattered. Also in Brunei and Kalimantan.

Ecology. In lowland to lower montane forests, up to 1500 m altitude, on sandy clay, sandy loam or granite-derived soils. Flowering and fruiting irregularly.

15. **Quercus sumatrana** Soepadmo

(of Sumatra)

Gard. Bull. Sing. 21 (1966) 387, *l.c.* (1968) 392, *l.c.* (1972) 393; Cockburn *l.c.* (1972) 229, *l.c.* (1976) 117; Anderson *l.c.* 204; Whitmore, Tantra & Sutisna *l.c.* 162. **Type:** *Achmat 1501*, N Sumatra, Tapah (holotype BO; isotype L).

Tree up to 40 m tall, 130 cm diameter; buttresses up to 2.5 m tall. **Bark** greyish, rough; inner bark fibrous. **Twigs** initially densely pubescent with brown stiff-hairs, glabrescent, smooth and lenticellate. Terminal buds ovoid to subglobose, 2–3 × 1.5–2 mm. **Stipules** linear, acute, membranous, 5–7 × 1 mm, densely fulvous tomentose with soft, short, simple hairs. **Leaves** *spirally arranged*, *chartaceous to thin-coriaceous*, glabrous and pale grey-brown above, *glaucous and sparsely pubescent with stiff simple hairs below*; elliptic or lanceolate, *(8–)12–18(–24) × (2–)3.5–7(–8) cm*, *base attenuate*, *acute*, *margin plane*, *remotely serrulate in the apical half*, *apex acute*; midrib prominent beneath, slightly raised above; *lateral veins (8–)10–12(–13) pairs*, *distantly spaced*, prominent below, slightly so above, parallel, arching towards the leaf margin, forming an angle of 45–60º with the midrib; *intercostal venation scalariform*, *obscure on both surfaces*; *petiole* slender, *15–25 mm long*, adaxially flat, sparsely tomentose. **Male** and **female inflorescences** unknown. **Cupules** *saucer-shaped*, *(0.7–)1–1.5 × (1.7–)2–2.5(–3) cm*, *covering 1/6–1/5 of the acorn*, *base flat*, densely tomentose on both surface; *rim up to 0.5 mm thick*; *lamellae 4–6*, *edge free*, denticulate. **Acorns** ovoid to conical, *1.5–2 × 2–2.5 cm*, densely sericeous, glabrescent; apex depressed with umbo up to 3 mm long, *base flat to concave*.

Vernacular name. Sabah and Sarawak—*mempening* (Malay).

Distribution. Sumatra and Borneo. In Sabah and Sarawak uncommon. Also in Kalimantan.

Ecology. In hill mixed dipterocarp forest to lower montane forest, up to 1300 m altitude, on sandy loam or basalt-derived soils. Fruiting between April and December.

16. **Quercus treubiana** Seemen

(Melchior Treub, 1851–1910; former Director of the Bogor Botanic Gardens, Indonesia)

Bull. Dép. Agr. Ind. Néerl. 1 (1906) 3; Merrill *l.c.* (1921) 216; A. Camus *l.c.* (1938) 368; Soepadmo *l.c.* (1968) 412, *l.c.* (1972) 398; Cockburn *l.c.* (1976) 117; Anderson *l.c.* 204; Whitmore, Tantra & Sutisna *l.c.* 162. **Type:** *Hallier 2915*, Borneo, Kalimantan, Mt. Lianggagang (holotype L; isotypes K, SAR). **Synonym:** *Cyclobalanopsis treubiana* (Seemen) Schottky *l.c.* 648.

Tree up to 30 m tall, 60 cm diameter; buttresses up to 1 m tall. **Bark** greyish brown, rough, peeling off into rectangular pieces; inner bark fibrous, yellowish or pale ochre. **Sapwood** brownish white. **Twigs** initially densely hairy with brownish simple hairs, glabrescent, lenticellate. Terminal buds ovoid to ellipsoid. **Stipules** linear, acute, 5–10 × 1–2 mm, densely pubescent outside, caducous. **Leaves** *spirally arranged*, thin-coriaceous, glabrous above, *densely pubescent with simple minute hairs below*; *linear to narrowly lanceolate*, *(3–)7–10(–12) × 1–3 cm*, base attenuate, acute, sometimes asymmetrical, margin entire or remotely serrulate in the apical half, *apex acute to acuminate*, acumen 5–10 mm long; midrib prominent on both surfaces; *lateral veins 5–10 pairs*, *distantly spaced*, parallel, arching towards the leaf margin, forming an angle of 45–60º with the midrib; *intercostal venation fine*, *scalariform*, *obscure on both surfaces*; *petiole* slender, *10–20 mm long*, adaxially flat, tomentose, glabrescent. **Male inflorescences** up to 3 cm long, densely pubescent; bracts linear, acute. **Male flowers** solitary or in dichasial clusters of three along the rachis; perianth 5–6-lobed, densely sericeous outside; stamens 5–6, filaments hairy at base, up to 2 mm long; pistillode replaced by a tuft of stiff simple hairs. **Female**

inflorescences 1–3-flowered, 1.5–3 cm long, densely hairy; bracts ovate, acute. **Female flowers:** perianth 5-lobed, densely hairy; ovary conical, *c.* 0.5 × 1.3 mm, styles 3, 1.5–2 mm long, densely pubescent at base. **Cupules** *cup-shaped*, *1–1.5 × 2–3 cm*, covering 1/3–1/2 of the acorn, base attenuate or rounded, woolly pubescent on both sides; *rim 1–1.5 mm thick*; *lamellae 10–12*, *edge tightly pressed towards cupule wall*, undulate. **Acorns** ovoid, subglobose or cylindrical, *2–2.5 × 2–3 cm*, glabrous; apex depressed, *base convex*.

Vernacular names. Sabah—*mempening* (Malay). Sarawak—*empili* (Iban).

Distribution. Sumatra and Borneo. In Sabah, known from Mt. Kinabalu and Mt. Tombuyokan. In Sarawak recorded for Hose Mts. in Kapit district, Bt. Lumut in Bintulu district, and Merurong Plateau. Also in Kalimantan.

Ecology. In hill mixed dipterocarp forest to montane forest, at 600–2100 m altitude, on sandy waterlogged soils. Fruiting between July and August.

17. **Quercus valdinervosa** Soepadmo

(Latin, *valde* = strongly or prominently, *nervosus* = nerved; the distinctly veined leaves)

Gard. Bull. Sing. 21 (1968) 404, *l.c.* (1972) 395; Cockburn *l.c.* (1976) 117; Anderson *l.c.* 204; Coode *et al.* (eds.) *l.c.* 127. **Lectotype** (Soepadmo, 1968)**:** *Clemens 31317*, Borneo, Sabah, Mt. Kinabalu (holotype K; isotypes A, B, K, L, SING, UC). **Synonym:** *Q. mespilifolia* Wall. *ex* A. DC. var. *borneensis* Heine, Fedde's Rep. 54 (1951) 54.

Tree up to 35 m tall, 60 cm diameter. **Bark** smooth, grey-brown; inner bark red-brown. **Sapwood** pale ochre. **Twigs** initially densely hairy with simple and stellate golden brown hairs, glabrescent, lenticellate. Terminal buds densely tomentose, ovoid to subglobose, 0.5–1 × 0.5 cm. **Stipules** densely hairy, linear, acute, 10–15 × 1–2 mm. **Leaves** *spirally arranged*, *thick-coriaceous*, *glabrous above*, *densely pubescent beneath*, *soon glabrescent*; elliptic, oblong or obovate, *(5–)6–13(–14) × (2.5–)3–5(–6) cm*, base attenuate, rounded, or acute, *margin plane*, *remotely serrate in the apical half*, *apex acute to acuminate*, acumen 5–10 mm long; midrib flat or impressed above, prominent beneath; *lateral veins 10–15 pairs*, *closely spaced*, *strongly prominent beneath*, parallel, arching towards the leaf margin, forming an angle of *c.* 60° with the midrib; *intercostal venation dense*, *scalariform*, *prominent beneath*; *petiole 12–25 mm long*, flat on the adaxial side, densely hairy, soon glabrescent. **Male inflorescences** many-flowered, 4–10 cm long; bracts triangular, acute, 3–5 × 2–3 mm, densely hairy with stiff golden brown hairs. **Male flowers:** perianth 5–6-lobed, densely hairy; stamens 6–9, filaments 3–4 mm long. **Female inflorescences** 4–6-flowered, 1.5–2 cm long, densely hairy; bracts narrowly ovate to linear, 1.5–2 × 1 mm. **Female flowers:** perianth 6-lobed, densely hairy; ovary conical, *c.* 0.6 × 0.8 mm, styles 3, recurved, 1.5–2 mm long. **Cupules** cup-shaped to bowl-shaped, *1.5–2 × 3–3.5 (–4) cm*, covering up to 1/3 of the acorn, base attenuate, rounded, densely hairy on both surfaces; *rim 2–4 mm thick*; lamellate 7–10, free edge crenate. **Acorns** ovoid, cylindrical or ellipsoid, densely tomentose, *3–4 × 1.5–3(–4) cm*; apex acute, base convex.

Vernacular name. Sabah and Sarawak—*mempening* (Malay).

Distribution. Endemic to Borneo. In Sabah known from Mt. Kinabalu. In Sarawak reported for Kelabit Highlands and G. Mulu. Also in Brunei and Kalimantan.

Ecology. In lower to upper montane forests, at 1300–2300 m altitude, on brownish ultrabasic and organic soils. Fruiting between February and August.

4. **TRIGONOBALANUS** Forman

(Greek, *trigonos* = 3-angled, *balanos* = acorn)

berangan beluyan (Iban), *mempening babi* (Malay).

Taxon 11 (1962) 140; Kew Bull. 17 (1964) 381, *ibid*. 21 (1967) 331; Soepadmo, FM 1, 7 (1972) 398; Cockburn, TFM 1 (1972) 232, TS 1 (1976) 119; Lozano-C, Caldesia 12 (1979) 517; Corner, WSTM 3rd. edition 1 (1988) 343; Nixon & Crepet, Am. J. Bot. 76 (1989) 828; Kubitzki *in* Kubitzki *et al*. (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 308.

Trees with *coppicing habit*. *Terminal bud solitary*. **Stipules** *interpetiolar*. **Leaves** (in Sabah and Sarawak) *in whorls of 3*; *margin toothed above the middle*; *petiole slightly thickened at the base*. **Inflorescences** *spikes*, male, female, androgynous or mixed. **Male inflorescences** *pendent* or *patent*, simple or *branched*, in the axils of normal lower (proximal) leaves or in the axils of reduced leaves and crowded together in lateral or subterminal paniculate clusters; bracts and bracteoles small, caducous. **Male flowers** in dichasial clusters of (1–)3–7(–12) along the rachis; perianth membranous, 6-lobed, the lobes imbricate; *stamens 6*, filaments free, exserted; *anthers basifixed*, ovoid, 2-loculed, *pistillode replaced by a cluster of erect simple hairs*. **Female, androgynous** or **mixed inflorescences** erect, simple or branched, solitary in the axils of upper (distal) leaves; bracts and bracteoles small, caducous. **Female flowers** in dichasial clusters of (1–)3–7(–15); perianth with 6 imbricate lobes, the lower part adnate to the ovary; *staminodes 6*, *well-developed and exceeding the perianth or remaining shorter than the perianth*, *sometimes polliniferous*; styles 3, recurved or connate at the base; *stigmas capitate*. **Cupules** *in condensed clusters of 2–3 or solitary along the rachis*, *partly enclosing 1–7(–12) nuts (fruits)*, 3–12-lobed, *outside covered with transversely dentate lamellae*. **Nuts** *trigonous in cross-section*, *ovoid to triangular in outline*; wall thinner than 0.5 mm, most part free from the cupule. Seed germination epigeal.

Distribution. Three species with disjunct distribution: *Trigonobalanus doichangensis* occurs in N Thailand; *T. verticillata* in Peninsular Malaysia, Borneo and C Sulawesi; and *T. excelsa* in Colombia, S America. In Borneo, *T. verticillata* occurs in Sabah and Sarawak.

Ecology. Confined to hill and lower montane forests, at 700–1800 m altitude.

Trigonobalanus verticillata Forman Fig. 17.

(Latin, *verticillatus* = whorled; the leaves)

Taxon 11 (1962) 140, *l.c.* (1964) 383, *l.c.* (1967) 331; Soepadmo *l.c.* (1972) 400; Cockburn *l.c.* (1972) 232, *l.c.* (1976) 119; Corner *l.c.* 343; Whitmore, Tantra & Sutisna *l.c.* 162; Turner *l.c.* 238. **Type:** *RSNB 2732A*, Borneo, Sabah, Mt. Kinabalu, Liwagu R. (holotype K; isotypes L, LE, US).

Tree up to 36 m tall, 70 cm diameter; producing many sucker-shoots at the base; low buttresses or stilt-roots occasionally present. **Bark** smooth, shallowly fissured to scaly, pale grey-brown; inner bark granular, reddish brown. **Sapwood** pale reddish. **Twigs** subglabrous, densely or sparsely minute-lenticellate. **Stipules** ovate, acute, 3–5 × 2 mm. **Leaves** *rigid*, *coriaceous*, *glabrous above*, *sparsely appressed tomentose with stellate hairs below*; elliptic or obovate, 5–8(–10.5) × (2.2–)2.5–4.5(–5.5) cm, base acute to cuneate, margin strongly revolute, toothed on the apical half, apex obtuse to rounded and emarginate; midrib raised on both surfaces, stronger below; *lateral veins thin*, *8–10(–11) pairs*, *lax or dense*, *prominent on both surfaces*, *stronger or sometimes flat below*, *arching and disappearing towards the leaf margin*, *forming an angle of 40–60° with the midrib*; intercostal venation reticulate, dense, obscure above, thinly prominent below; petiole (3–) 4–10 mm long. **Male inflorescences** 4–10 cm long; bracts and bracteoles broadly ovate, 1–1.5 × 0.8 mm. **Male flowers** solitary but arranged closely together along the rachis; perianth 5–6-lobed, lobes coriaceous, elliptic, *c.* 1 × 0.8 mm; stamens 5–6, filaments 1.5–2 mm long. **Androgynous** or **mixed inflorescences** 5–10 cm long; bracts and bracteoles broadly ovate, 0.8–1 × 0.5–0.8 mm. **Female flowers** in dichasial clusters of (2–)3–7(–15) along the rachis; perianth 5–6-lobed, lobes coriaceous, elliptic *c.* 1 × 0.8 mm; staminodes 5–7; styles 3, cylindrical, straight, 1.5–2 mm long. **Cupules** *sessile*, *open*, *3–12-lobed*, the lobes acute, 4–8 × 3–6 mm, densely appressed tomentose on both sides; wall bony, thin, *usually containing 2–3 nuts*; *scale-like appendages minute*, *distinct*, set irregularly. **Nuts** ovoid to conical, 5–7 × 3–5 mm, sparsely tomentose, brownish; base truncate, apex acute; *scar flat*, *triangular*, *c.* 2 mm diameter; *wall bony*, *thin*, *most part free from the cupule.*

Vernacular names. Sabah—*mempening babi* (Malay). Sarawak—*berangan beluyan* (Iban), *salad rettan* (Kelabit), *mengkusub* (Tagar).

Distribution. Peninsular Malaysia, Borneo and C Sulawesi. In Sabah, common in Ranau district (Kundasang, Kinasaraban, Sosopodon, and Kinabalu Park) and once collected from Bt. Rimau, Long Pasia in Sipitang district. In Sarawak, common in Lawas area, and in Bario and Mt. Hose in Kapit district. Not known in Brunei and Kalimantan.

Ecology. In primary and old secondary hill to lower montane forests, including *kerangas* forest, at 700–1600 m altitude, on ultrabasic or loamy soils overlying Tertiary sandstone; often gregarious along streams. Flowering in September–February, fruiting in April–November.

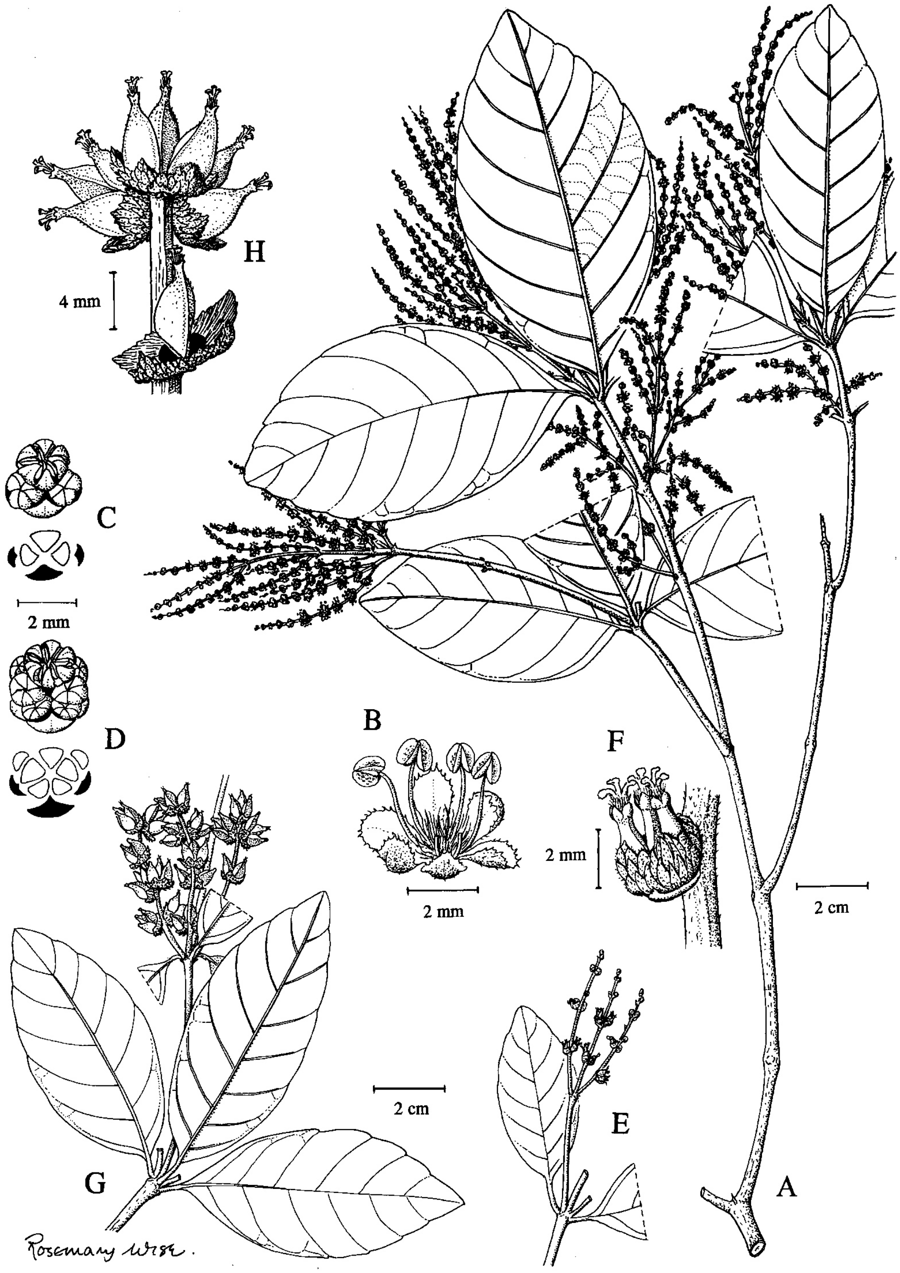

Fig. 17. *Trigonobalanus verticillata.* A, leafy flowering (male) twig; B, male flower; C, 3-flowered dichasial cluster of male flowers; D, 7-flowered dichasial cluster of male flowers; E, leafy flowering (female) twig; F, 3-flowered dichasial cluster of female flowers; G, leafy fruiting twig; H, a portion of infructescence. (A–D from *S. 33077*, E–F from *SAN 29003*, G–H from *SAN 56707*.)

LEGUMINOSAE

(Subfamily **CAESALPINIOIDEAE)**

Ding Hou

Rijksherbarium/Hortus Botanicus
Leiden, the Netherlands

Backer *in* Hooker *f.*, Fl. Brit. Ind. 1 (1876) 60 (as suborder Caesalpinieae); Prain, J. As. Soc. Beng. 66, 2 (1897) 152 (as suborder Caesalpinieae); Ridley, FMP 1 (1922) 616 (as suborder Caesalpinieae); Backer & Bakhuizen *f.*, FJ 1 (1964) 523 (as Caesalpiniaceae); Hutchinson, Gen. Fl. Pl. 1 (1964) 221 (as Caesalpiniaceae); Keng, OFMSP (1969) 65; Whitmore, TFM 1 (1972) 245; Cockburn, TS 1 (1976) 156; Anderson, CLTS (1980) 231 (as part of Leguminosae); Cowan *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 57; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 1; Corner, WSTM 3rd. edition 1 (1988) 418 (as Caesalpiniaceae); Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 193 (as part of Leguminosae); Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area (1994) 71 (as Caesalpiniaceae); Turner, Gard. Bull. Sing. 47, 1 (1995) 289 (as part of Leguminosae); Ding Hou, K. & S.S. Larsen, FM 1, 12 (1996) 409 (as Caesalpiniaceae); Coode *et al.* (eds.), CLBD (1996) 160; Loo & Tan, Gard. Bull. Sing. 49, 1 (1997) 55 (as Caesalpinaceae); Argent *et al.* (eds.), MNDT-CK 2 (1997) 342 (as part of Leguminosae).

Trees, shrubs, or woody lianas; sometimes armed with thorns or spines; bole sometimes buttressed. Stipels usually lacking, or minute when present. **Stipules** *usually present*, *often caducous*. **Leaves** often spiral, *compound* (*once pinnate or bipinnate*, *rarely unifoliolate*) *or simple*, *petiolate*. **Inflorescences** axillary and/or terminal, or borne on older branches and stems, solitary or fascicled, *commonly paniculate*, *through reduction and condensation leading to racemose*, *spicate*, *rarely 1-flowered*; bracts and bracteoles usually present, often caducous. **Flowers** *usually bilaterally symmetrical* or less often radially symmetrical, bisexual and/or unisexual, *usually 5-merous except for the gynoecium*; *hypanthium (or receptacle) usually present*, cupular, tubular, or turbinate, sometimes obscure or absent, inside often containing nectariferous tissue; *calyx lobes or sepals generally 5*, sometimes 4, usually imbricate; *petals usually 5*, *sometimes reduced to 4 (or 1)*, *or 0*, *often unequal*; disk sometimes present and extrastaminal; *stamens basically 10*, *mostly unequal*, *rarely fewer*, *or 0* (in female flowers), all fertile or some reduced; *filaments free or variously connate at the base*; *anthers* variously developed, *basi- or dorsifixed*, often versatile, *usually longitudinally dehiscent*, *rarely dehisce by apical or basal pores*; pistil stipitate and often partly adnate to the hypanthium, rarely sessile; *ovary (1–)few–many-ovuled*, style short or long, often curving inward, stigma large or small, capitate or peltate, sometimes obscure. **Fruit** variable, usually *a pod*, oblong to linear or strap-shaped, laterally compressed, straight or curved, *dehiscent and 2-valved*, valves chartaceous, fleshy, coriaceous, or woody, thick, *indehiscent and drupaceous*, *or winged*; with or without pulp; glabrous, hairy, or spiny. **Seeds** varying in form, often flattened; testa membranous, coriaceous, or crustose; *sometimes arillate*; *endosperm present or lacking*; cotyledons fleshy or foliaceous, radicle straight or slightly oblique, never folded.

Distribution. Predominantly tropical plants comprising about 160 genera and over 2000 species. In Sabah and Sarawak, the subfamily is represented by 42 species in 17 genera.

Ecology. In tropical primary and secondary forests mostly at low and medium altitudes to 600(–1500) m, growing on hillsides, ridges, river banks, swampy or marshy places, or just behind the mangroves, occasionally on limestone or sandstone.

Uses. Members of some genera, e.g., *Afzelia*, *Cynometra*, *Intsia*, etc., are sources for important (commercial) timbers. Some species produce resin or wood-oil, medicine, or tannin. Trees of some species are cultivated for ornamental purpose.

Key to genera

(for flowering specimens)

1. Leaves simple, bilobed, or deeply divided (as 2 free leaflets)…..…………………....…….….

Bauhinia L.

Sp. Pl. 1 (1753) 374; Prain, J. As. Soc. Beng. 66, 2 (1897) 175; Ridley, FMP 1 (1922) 624; Backer & Bakhuizen *f.*, FJ 1 (1964) 531; Corner, WSTM 3rd. edition 1 (1988) 419; Coode *et al.* (eds.), CLBD (1996) 160; K. Larsen & S.S. Larsen, FM 1, 12 (1996) 442; Loo & Tan, Gard. Bull. Sing. 49, 1 (1997) 57. Synonyms: *Phanera* Lour., Fl. Coch. (1790) 37, de Wit, Reinwardtia 3 (1956) 435; *Bracteolanthus* de Wit *l.c.* (1956) 415; *Lysiphyllum* (Benth.) de Wit *l.c.* (1956) 431.

A pantropical genus consisting of about 300 species. About 28 species are found in Sabah and Sarawak.

Woody tendrilled climbers, shrubs or trees. Leaves *simple*, *bilobed*, *or deeply divided (as 2 free leaflets)*; venation palmate (or fan-like), or parallel. Flowers bisexual, solitary, or in racemes, corymbs or panicles; calyx cup-shaped, 2–5-lobed; petals usually 5, subequal; stamens 0–10 fertile, staminodes often present; ovary 1–many-ovuled. Fruits usually dehiscent. In various habitats, from lowland to lower montane forest up to 1500 m altitude.

Leaves compound, rarely unifoliolate (as a simple leaf)........………......…………………2

2. Leaves bipinnate........…………………………………………..…....……………3
Leaves once pinnate (paripinnate or imparipinnate), rarely unifoliolate.........…………..6

3. Plants armed with spines or prickles........……………………………....……………..4
Plants not armed.........…………………………………………………....……………5

4. Floral parts often punctate; calyx lobes and petals usually bilaterally symmetrical; ovary 1–10(–13)-ovuled.........………………………………..........……..…..………..

Caesalpinia L.

Sp. Pl. (1753) 380; Prain, J. As. Soc. Beng. 66, 2 (1897) 225; Ridley, FMP 1 (1922) 648; Backer & Bakhuizen *f.*, FJ 1 (1964) 544; Whitmore, TFM 1 (1972) 246; Hattink, Reinwardtia 9 (1974) 9; Corner, WSTM 3rd. edition 1 (1988) 426; Ding Hou, FM 1, 12 (1996) 535; Coode *et. al.* (eds.), CLBD (1996) 161; Loo & Tan, Gard. Bull. Sing. 49, 1 (1997) 60. Synonym: *Poinciana* L., Sp. Pl. (1753) 380, Backer & Bakhuizen *f. l.c.* 546.

A pantropical genus consisting of about 100 species. In Sabah and Sarawak represented by 6 indigenous species.

Lianas, shrubs, or small trees, *usually spiny or prickly*. Leaves *bipinnate*; rachises on the underside often with prickles; leaflets few to many pairs, no terminal leaflet. Inflorescences axillary and/or terminal, racemose or paniculate. Flowers usually bisexual, *bilaterally symmetrical*, *all parts often punctate* (secretory cavities); hypanthium usually obliquely short-cupular or funnel-shaped; calyx lobes 5, unequal, the lowest one hood-shaped; petals 5, unequal; stamens 10, free, anthers uniform; *ovary* flat, *1–10(–13)-ovuled*. Fruits very variable, dehiscent or indehiscent, more or less flattened, wingless or winged along the upper suture, 1–10(–13)-seeded. Seeds orbicular or globose, ellipsoid or reniform, sometimes flattened, often smooth, usually without endosperm.

Mostly in secondary vegetation, sometimes in coastal, rarely in primary forest, on various types of soils from sea level to *c*. 1700(–2000) m altitude.

Floral parts not punctate; calyx lobes and petals slightly unequal; ovary 1–2-ovuled........

Pterolobium R. Brown *ex* Wight & Arn., *nom. cons.*

Prod. Fl. Ind. Orient. 1 (1834) 283; Prain, J. As. Soc. Beng. 66, 2 (1897) 235; Ridley, FMP 1 (1922) 648; Backer & Bakhuizen *f.*, FJ 1 (1964) 543; Ding Hou, FM 1, 12 (1996) 654.

About 11 species in the Old World. Only 1 species (*P. borneense* Merr.) in Sarawak: Baram district; also known in Kalimantan.

Tall climbers or climbing shrubs *armed with recurved prickles*. Leaves *bipinnate*; leaflets numerous, small. Flowers bisexual, in terminal or axillary panicles of racemes; calyx 5-lobed; petals 5, the upper one (standard) usually different in shape and size; stamens 10, free; *ovary* free, *1–2-ovuled*. *Fruits samaroid*, basal seed-bearing part flattened, indehiscent, usually 1-seeded; upper wing-like part membranous.

In lowland forest up to 500 m altitude.

5. Leaflets (1–)2(3–6) pairs per pinna. Petals 2.5–5 mm long; stamens with glabrous filaments..**13. Sympetalandra** (in part)
Leaflets often 4–27 pairs per pinna. Petals 12–25 mm long; stamens with filaments pilose or villous at the base or basal part.......................................**10. Peltophorum**

6. Leaves imparipinnate, rarely unifoliolate..7
Leaves paripinnate..11

7. Petals 5..8
Petals absent or greatly reduced..9

8. Leaves with only 1 leaflet..**14. Uittienia**
Leaves with 5–12(–17) leaflets..**8. Koompassia**

9. Calyx lobes 5 or 3; stamens 2 or 6..**6. Dialium**
Calyx lobes 4; stamens usually 10..10

10. Inflorescences racemose. Ovary 1–6-ovuled..**4. Crudia**
Inflorescences paniculate. Ovary 2-ovuled..**3. Copaifera**

11. Petals absent..**11. Saraca**
Petals present, 1–5..12

12. Petal only 1 developed, the others rudimentary or wanting.....................................13
    Petals often 2–5 developed...15

13. Calyx lobes often spiny outside; fertile stamens often 10...........................**12. Sindora**
    Calyx lobes smooth outside; fertile stamens 3–8...14

14. Stamens often (5–)7 fertile...**1. Afzelia**
    Stamens often 3 fertile...**7. Intsia**

15. Petals 2 (or 1); fertile stamens 2...**9. Leucostegane**
    Petals usually 5; fertile stamens usually 10..16

16. Calyx and corolla pellucid-glandular; stamens 10, alternately long and short..............
    ....**13. Sympetalandra** (in part)
    Calyx, corolla and stamens not as above...17

17. Leaves with 4–12 pairs of symmetrical leaflets. Stamens 3 + 7, unequal (3 almost twice as long as the others); ovary many-ovuled...**2. Cassia**
    Leaves usually with only 1 or 2 pairs of asymmetrical leaflets. Stamens (8–)10 (–15), equal in length; ovary 1–2(– 4)-ovuled...................................**5. Cynometra**

Key to genera

(for fruiting specimens)

1. Leaves simple, bilobed, or deeply divided (as 2 free leaflets)..............................**Bauhinia**
   Leaves compound or unifoliolate (as a simple leaf)..2

2. Leaves bipinnate..3
   Leaves once pinnate (paripinnate or imparipinnate), or unifoliolate.............................7

3. Plants armed with spines or prickles..4
   Plants not armed..6

4. Fruits not winged...**Caesalpinia** (in part)
   Fruits winged...5

5. Fruits samaroid, winged above the seed-bearing part.......................................**Pterolobium**
   Fruits winged along one suture side...**Caesalpinia** (in part)

6. Fruits indehiscent...**10. Peltophorum**
   Fruits dehiscent, 2-valved...**13. Sympetalandra** (in part)

7. Leaves imparipinnate...8
   Leaves paripinnate..12

8. Fruits surrounded by a papery wing..**8. Koompassia**
   Fruits not winged..9

9. Fruit a pod, dehiscent........……………………...………………….………………...10
Fruit drupaceous, indehiscent.........……………………….......……………………......11

10. Fruits 1–4(–6)-seeded; seeds without aril............………….…...……………...**4. Crudia**
Fruits 1–2-seeded; seeds enclosed by 2-lobed aril…......………...………….**3. Copaifera**

11. Fruits with a thin-crustaceous, usually hairy exocarp, easily crushed or sometimes detached from mesocarp. Leaves each usually with (1 or) 3 or more leaflets......………… ………………………………………………………………...………...**6. Dialium**
Fruits with a crustaceous, glabrous exocarp united with a thick (4–5 mm) and hard mesocarp, uncrushable when pressed hard between two hands. Leaves with only 1 leaflet.....…………………………………………...……………...**14. Uittienia**

12. Fruits often spiny outside.........…………………………...………………..**12. Sindora**
Fruits smooth or rugose outside........………………...………………………….…………13

13. Fruits indehiscent........…………………………….....…………………………….……14
Fruits dehiscent.........………………………….......…………………………..……...15

14. Fruits elongate, cylindrical, 20–60 cm long, many-seeded. Leaves with 4–12 pairs of leaflets........………………………………………………….....……......**2. Cassia**
Fruits broad ovoid or broadly ellipsoid, or obovoid, less than 8 cm long, 1(–4)-seeded. Leaves with 1 or 2 pairs of leaflets, rarely unifoliolate………...………...**5. Cynometra**

15. Stipules foliaceous, often (5–)12.5–40 mm long, persistent…...……….**9. Leucostegane**
Stipules minute, caducous........………………………....……………….……………16

16. Seeds distinctly arillate.......………………………………...………………..…..**1. Afzelia**
Seeds not arillate.......………………………………....……………………….……...17

17. Valves of fruits twisting and enrolling, or coiling during dehiscence..........….**11. Saraca**
Valves of fruits often straight or slightly twisting during dehiscence.........…………...18

18. Leaflets usually with 1 or 2 small crateriform glands at the basal part on lower surface. Valves of fruits leathery or slightly woody........…………………...……...**7. Intsia**
Leaflets without the glands as above. Valves of fruits distinctly woody……...……… ……………………………………………...………**13. Sympetalandra** (in part.)

1. **AFZELIA** Sm., *nom. cons.*

(A. Afzelius, 1750–1837, Sweden, one of the best students of Linnaeus, Professor of Botany at Upsala, collected plant specimens in the west coasts of Africa)

Trans. Linn. Soc. 4 (1798) 221, *non* J.E. Gmelin, 1791 (= *Seymeria* Pursh, Scrophulariaceae); Prain, J. As. Soc. Beng. 66, 2 (1897) 207; Ridley, FMP 1 (1922) 639; Cockburn, TS 1 (1976) 157; Anderson, CLTS (1980) 232; Cowan & Polhill *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 128; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 194; Ding Hou, FM 1, 12 (1996) 438; Argent *et al*. (eds.), MNDT-CK 2 (1997) 346. **Synonym:** *Pahudia* Miq., Fl. Ned. Ind. 1, 1 (1855) 85.

Trees. **Stipules** interpetiolarly connate at base, *minute*, *caducous*. **Leaves** *compound*, *once pinnate and paripinnate*. **Leaflets** chartaceous, shortly petiolulate, *petiolules often turned or twisted*. **Inflorescences** terminal or axillary, racemose, often fasciculate or paniculate; bracts and bracteoles small, often caducous. **Flowers** *bisexual*, *bilaterally symmetrical*, pedicelled; *hypanthium cupular*, *narrowly infundibuliform or cylindrical*, puberulous outside, glabrous inside; *calyx lobes 4*, imbricate, puberulous and *smooth on both surfaces*; *petals only one fully developed*, *large*, *flabellate*, lower half narrowed into a claw, the others small or absent; *stamens 9*, *usually (5–)7 fertile*, *almost equal*; *ovary 3–8(or more)-ovuled*. **Fruits** *smooth outside*, *dehiscent*, oblong, obliquely oblong, or slightly rhomboid, *compressed*, black when ripe, glabrous, *2-valved*; valves thick, woody; *often 3(or more)-seeded*. **Seeds** ellipsoid, ovoid-oblong or broadly ellipsoid, smooth, without endosperm; *aril yellow*, orange, or red, *often 2-lobed*, *covering the seed for up to half or more of its length*.

Distribution. About 12 species, in tropical Africa, Asia and S China; 1 species in Sabah and Sarawak.

Ecology. In forest at low and medium altitudes, up to 400(–1400) m.

Afzelia rhomboidea (Blanco) Vidal Fig. 1.

(Latin, *rhomboideus* = oval, a little angular in the middle; the fruits)

Cat. Pl. Prov. Manila (1880) 28; Whitmore, Tantra & Sutisna *l.c.* 194; Ding Hou *l.c.* (1994) 316, *l.c.* (1996) 441; Argent *et al*. (eds.) *l.c.* 348. **Basionym:** *Eperua rhomboidea* Blanco, Fl. Filip., ed. 2 (1845) 260. **Neotype** (Ding Hou, 1994)**:** *Merrill Sp. Blanc. no. 862*, the Philippines, Luzon, Laguna Prov. (holotype L; isotype BO). **Synonyms:** *Pahudia rhomboidea* (Blanco) Prain, Sc. Mem. Med. Off. Army Ind. 12 (1901) 46, Merrill, Spec. Blanc. (1918) 171; *Intsia acuminata* Merr., Publ. Gov. Lab. Philip. 17 (1904) 20; *A. borneensis* Harms in Fedde, Rep. Sp. Nov. 14 (1916) 256, Cockburn *l.c.* 157, Anderson *l.c.* 232, Whitmore, Tantra & Sutisna *l.c.* 194; *P. acuminata* (Merr.) Merr., Philip. J. Sc. 11 (1916) Bot. 86; *A. acuminata* (Merr.) Harms in Fedde, Rep. Sp. Nov. 15 (1917) 19; *P. borneensis* (Harms) Merr., J. Str. Br. R. As. Soc. 76 (1917) 84, EB (1921) 297, Masamune, EPB (1942) 349; *P. rhomboidea* (Blanco) Prain var. *praetermissa* de Wit, Bull. Bot. Gard. Buitenz. 3, 17 (1941) 151; *A. rhomboidea* (Blanco) Vidal var. *praetermissa* Léonard, Reinwardtia 1 (1950) 63.

Tree up to 36 m tall, 80(–120) cm diameter; bole cylindrical; buttresses sometimes present, up to 2 m high. **Bark** dark grey, deeply pock-marked; inner bark deep green-brown. **Sapwood** pale yellow, heartwood bright orange-red. **Twig** *often hollow*; young twig, rachis, petiole, petiolules, and leaflets often glabrous, sometimes sparsely, very rarely densely pubescent, especially on the midrib of the lower (sometimes also on the upper) leaf surface. **Leaves** 10–14(–19) cm long, *each with 3–5 pairs of leaflets*. **Leaflets** ovate, elliptic, 3.5–10(–15) × 2.5–4.5(–6) cm, base acute or obtuse, rarely more or less truncate or shallowly concave, apex (shortly)acuminate; lateral veins 5–8 per side, intercostal venation rather closely reticulate; petiolules 1.5–4.5 mm long. **Inflorescences** 12–14(–15) cm long, both main axis and branches puberulous; pedicel 4.5–5.5 mm long. **Flowers:** calyx lobes broadly ovate or subrotundate, 5–12 × 5–9 mm; developed petals 7–10 × 5–9 mm; stamen filaments slightly hairy near the base; ovary puberulous along the margin, *style of two kinds*: *long (40–50 mm)*, *or very short (1–2 mm)*, slightly hairy at the base. **Fruits** 9–12(–20) × 5–

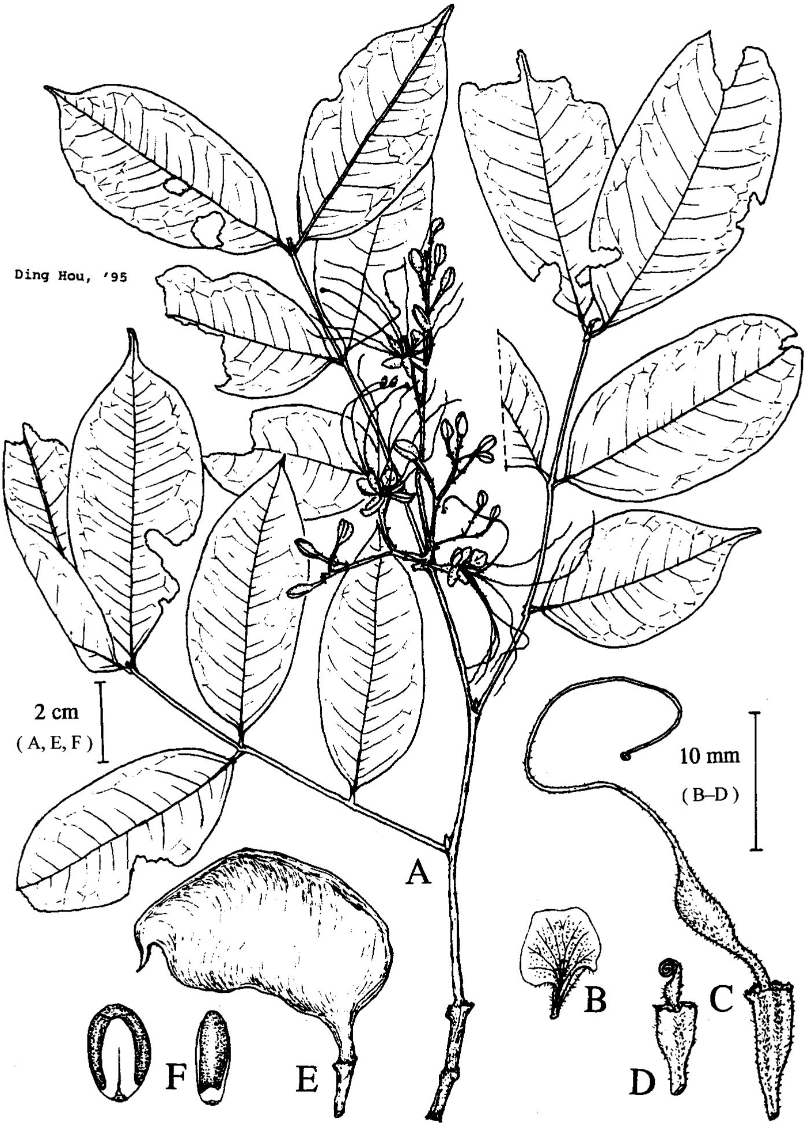

Fig. 1. *Afzelia rhomboidea.* A, flowering leafy twig; B, inside view of petal; C and D, two forms of pistils; E, young fruit; F, arillate seeds in different views. (After FM 1, 12 (1996) 440, f. 3 a–f.)

7(–10) × 1.5 cm, 2–6-seeded. **Seeds** 1.7–3 × 1.5–2.5 × 1 cm, *black with a rich orange aril*.

Vernacular names. Sabah—*ipil darat* (preferred name), *merbau tanduk* (Malay, Tawau).

Distribution. Sumatra, Borneo and the Philippines. In Sabah scattered, known for Kalabakan and Tawau in Tawau district, and Mt. Kinabalu in Ranau district. In Sarawak, known by a single record from Semengoh Arboretum in Kuching district. Also in Kalimantan.

Ecology. In primary forest, occasionally occurring on limestone or sandstone, up to 350 m altitude, once found at *c.* 1400 m on Mt. Kinabalu. Flowering and fruiting almost all year round.

Use. Valuable timber tree, fresh logs sink.

2. **CASSIA** L.

(from the Greek name *kassia*)

Sp. Pl. 1 (1753) 376; Prain, J. As. Soc. Beng. 66, 2 (1897) 153; Ridley, FMP 1 (1922) 616; Backer & Bakhuizen *f.*, FJ 1 (1964) 535; Whitmore, TFM 1 (1972) 246; Cockburn, TS 1 (1976) 158; Anderson, CLTS (1980) 232; Irwin & Barneby *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 105; Mem. N.Y. Bot. Gard. 35 (1982) 4; K. Larsen & S.S. Larsen, Fl. Thail. 4 (1984) 102, *p.p.*; Corner, WSTM 3rd. edition 1 (1988) 428; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 197; Rudd, Rev. Handb. Fl. Ceylon 7 (1991) 59, *p.p.*, *excl. syn.*; K. Larsen & Ding Hou, FM 1, 12 (1996) 556; Coode *et al.* (eds.), CLBD (1996) 162; Argent *et al.* (eds.). MNDT-CK 2 (1997) 352.

Trees or large shrubs. **Leaves** spirally arranged, often distichous, *compound*, *once pinnate and paripinnate*, *each with 4–12 pairs of symmetrical leaflets*; extrafloral nectaries absent. **Inflorescences** terminal on main branches or on short side shoots, racemose. **Flowers:** hypanthium variable; *calyx lobes 5*; *petals 5*; *stamens 10*, *unequal (3 + 7)*: 3 with filaments curved, usually longer than the others, and anthers dehiscing by slits, the remaining 7 filaments straight and short with anthers mostly dehiscing by basal pores; *ovary many-ovuled*. **Fruits** *smooth outside*, *elongate*, *cylindrical or compressed*, *indehiscent*, *20–60 cm long*. **Seeds** *many*, *1–2-seriate*, *without aril*.

Distribution. About 30 species, in tropical America, Africa, Asia, Malesia and Australia. In Sabah and Sarawak, only one indigenous species is recorded.

Cassia javanica L.

(of Java)

Sp. Pl. (1753) 379; Prain *l.c.* 156; Merrill *l.c.* (1921) 299; Masamune *l.c.* 338; de Wit, Webbia 11 (1955) 214; Backer & Bakhuizen *f. l.c.* 537; Burkill, EPMP 1 (1966) 476; Verdcourt, Lae Bot. Bull. 11 (1979) 47; K. Larsen & S.S. Larsen, Fl. Cambodia, Laos & Vietnam 18 (1980) 84; Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 46; K. Larsen & S.S. Larsen, Fl. Thail. 4 (1984) 107; Corner *l.c.* 431; Whitmore,

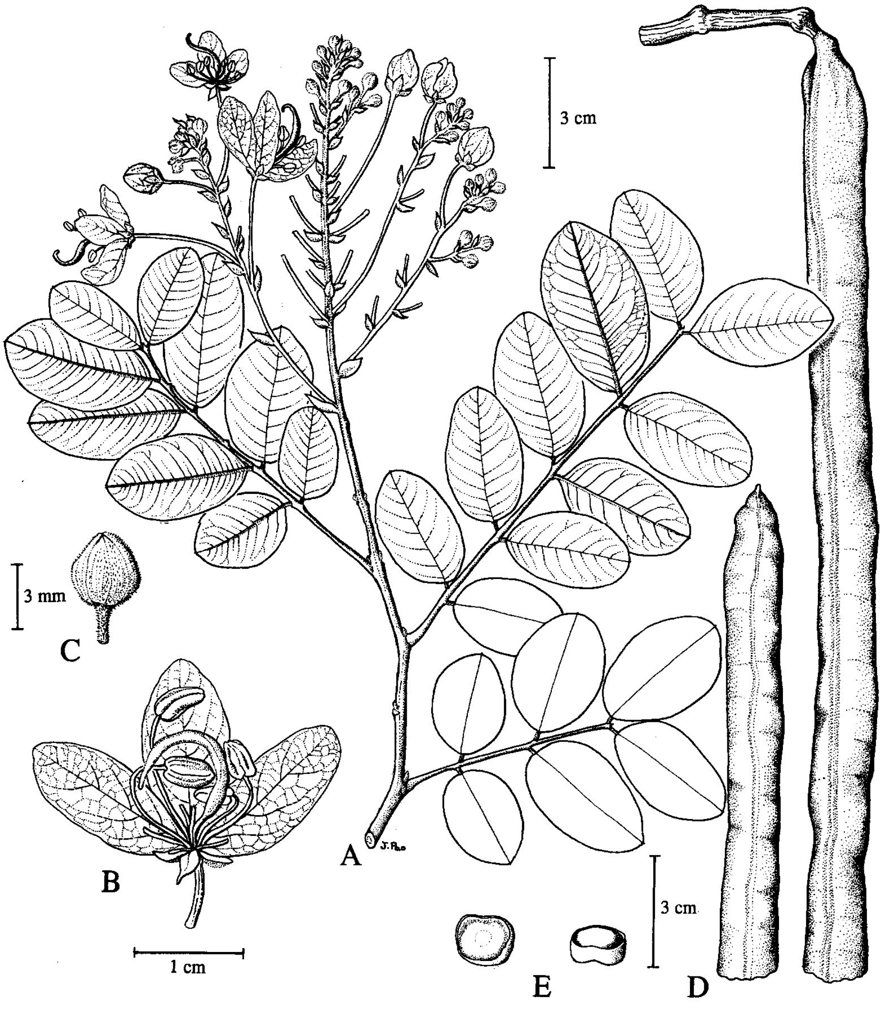

Fig. 2. *Cassia javanica* subsp. *nodosa*. A, leafy flowering twig; B, open flower; C, flower bud; D, fruit; E, seeds in different views. (A–C from *Hamid FD. FMS 36038*, D–E from *Kochummen FRI 2942*.)

Tantra & Sutisna *l.c.* 198; K. Larsen & Ding Hou, FM 1, 12 (1996) 560; Argent *et al.* (eds.) *l.c.* 352. **Type** (de Wit, 1955): *Commelin s.n.*, Hort. Med. Amst. 1 (1697) 217, *t.* 111.

Distribution. A very polymorphous species with a wide distribution ranging from N India through the Indo-Chinese Peninsula and the Malesian region to New Guinea; with 5 subspecies widespread in the Malesian area, wild and cultivated; one of them in Sabah and Sarawak.

subsp. **nodosa** (Buch.-Ham. *ex* Roxb.) K. Larsen & S.S. Larsen Fig. 2.
(Latin, *nodus* = node; with nodes or joints)

Nat. Hist. Bull. Siam Soc. 25 (1974) 205, *l.c.* (1980) 85, *l.c.* (1984) 108; Rudd *l.c.* 68; Turner, Gard. Bull. Sing. 47, 1 (1995) 296; K. Larsen & Ding Hou *l.c.* (1996) 564. **Basionym:** *C. nodosa* Buch.-Ham. *ex* Roxb., Fl. Ind. ed. 2, 2 (1832) 336, Ridley *l.c.* (1922) 616, de Wit *l.c.* (1955) 223, Backer & Bakhuizen *f. l.c.* 537, Cockburn *l.c.* 158, Anderson *l.c.* 233, Irwin & Barneby *l.c.* (1982) 50, Corner *l.c.* 431, Keng, Conc. Fl. Sing. (1990) 33; Whitmore, Tantra & Sutisna *l.c.* 198, Ng, MFFSS 2 (1992) 427. **Type** (Irwin & Barneby, 1982)**:** Authentic collection from Hort. Bot. Calcutta., distributed as *Wallich Herb. no. 5331* (K-W), a native of Chittagong, India.

Deciduous tree, up to 35 m tall, 36 cm diameter; *trunk unarmed*. **Leaves** *each with 4–12 pairs of leaflets*. **Leaflets** elliptic-ovate to oblong, 4–10 × 1.5–3.5 cm, base obtuse or rounded, apex acute; lower surface pubescent, glabrescent. **Inflorescences** axillary, racemose, corymbose, 4–10 cm long; peduncle 2–3 cm long; pedicel 2–3.5 cm long. **Flowers** white, later pink; calyx lobes green in living state, ovate, *c.* 6 mm long; petals obovate, 1.5–2 mm long, contracted into a short claw; *stamens*: *3 long ones* with the filament recurved, 15–20 mm long, *with a spherical enlargement near the middle of the 20 mm long filament*, 7 shorter ones 10–12 mm long. **Fruits** *dangling*, *round*, *black*, *30–70 × 1.2–2 cm*. **Seeds** *many*, pale brown, flat, more or less orbicular, 0.8–1 cm diameter.

Vernacular names. Sabah—*barung-barung* (Malay), *busuk-busuk* (preferred name), *langgong* (Kalabakan).

Distribution. E Himalayas, southern Thailand, through Peninsular Malaysia, Borneo to Java and Lesser Sunda Islands. In Sabah scattered in most districts; in Sarawak, rare, reported from Lundu district.

Ecology. In primary forests at low altitude.

3. **COPAIFERA** L., *nom. cons.*

(Derived from *copaiba*, the Brazilian name for the balsam of *capevi*, and Latin, *-fer* = to bear or to carry; tree producing the balsam of *capevi*)

Sp. Pl. ed 2 (1762) 557; Anderson, CLTS (1980) 233; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 198; Ding Hou, Blumea 38 (1994) 320, FM 1, 12 (1996) 570; Coode *et al.* (eds.), CLBD (1996) 162.

Synonym: *Pseudosindora* Symington, Proc. Linn. Soc. Lond. 155 (1944) 285, Cowan & Polhill *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 132.

Trees. **Leaves** *compound*, *once pinnate and imparipinnate*, petiolate; leaflets alternate, petiolulate. **Stipules** caducous. **Inflorescences** axillary, *paniculate*; bracts and bracteoles small, caducous. **Flowers** *bisexual*, *radially symmetrical*, pedicelled; hypanthium unknown; *calyx lobes 4*, narrowly imbricate or subvalvate; *petals absent*; *stamens 10*, free; anthers dorsifixed; *ovary 2-ovuled*, style slender, stigma small, capitellate. **Fruits** *not winged*, *dehiscent pods*, ellipsoid, rather smooth, 2-valved; valves thick-coriaceous; *1–2-seeded*. **Seeds** without endosperm, oblong, *enclosed by 2-lobed aril*.

Distribution. A genus comprising 25–30 species, mostly in tropical America, 4 in tropical Africa, and one in Borneo. In Sabah and Sarawak one species; also in Brunei and Kalimantan.

Copaifera palustris (Symington) de Wit Fig. 3.

(Latin, *palustris* = swampy, marshy; plants growing in marshy habitats)

Webbia 9 (1954) 462; Anderson *l.c.* 233; Whitmore, Tantra & Sutisna *l.c.* 198; Ding Hou *l.c.* (1994) 321, *l.c.* (1996) 573; Coode *et al.* (eds.) *l.c.* 162. **Basionym:** *Pseudosindora palustris* Symington, Proc. Linn. Soc. Lond. 155 (1944) 285, Browne, FTSB (1955) 242. **Type:** *Flemmich FMS 32600*, Borneo, Brunei (holotype KEP).

Tree up to 40 m tall, 180 cm diameter, not buttressed. **Bark** minutely fissured. **Stipules** auriculate to subfalcate, up to 15 × 10 mm. **Leaves** 4.5–12 cm long, glabrous. **Leaflets** *(2–)4(–6) for each leaf*, coriaceous, glossy, *pellucid-dotted*, glabrous except sometimes sparsely hairy on the midrib or at the base on the lower surface, glabrescent; elliptic-oblong, often unequally sided, 5–9(–14) × 3.5–6(–8) cm, base rounded, apex acute or shortly acuminate; lateral veins many, distinct or visible on both surfaces; *often with 1–3 elliptic*, *slightly depressed glands towards the basal part of the margin*; petiolules 4–7 mm long. **Inflorescences** 4–11 cm long; pedicel 3–4 mm long. **Flowers:** calyx lobes elliptic, 4–7.5 × 2–4 mm, puberulous outside, densely tomentose inside; *stamens alternately long and short*. **Fruits** 4.5–7.5 × 3.5–4 cm. **Seeds** 2.4–2.7 × *c.* 1.5 cm, glossy brown or black; aril narrowly 2-lobed, enclosing the seed.

Vernacular names. Sabah—*sepetir paya* (preferred name). Sarawak—*sepetir paya* (preferred name), *tepih* (Melanau, Rejang).

Distribution. Endemic to Borneo. In Sabah uncommon; in Sarawak known from Betong, Bintangor, Marudi, Miri, and Sibu districts. Also in Brunei and Kalimantan.

Ecology. In peatswamp forest near the coast, sometimes also found in well-drained lowland forest, once found in secondary heath forest, up to 30 m altitude. Flowering in April and October; fruiting in July.

Uses. The timber of this species is similar to that of *Sindora* and can be used for the same purposes. (*cf.*: PROSEA 5, 1 (1993) 437).

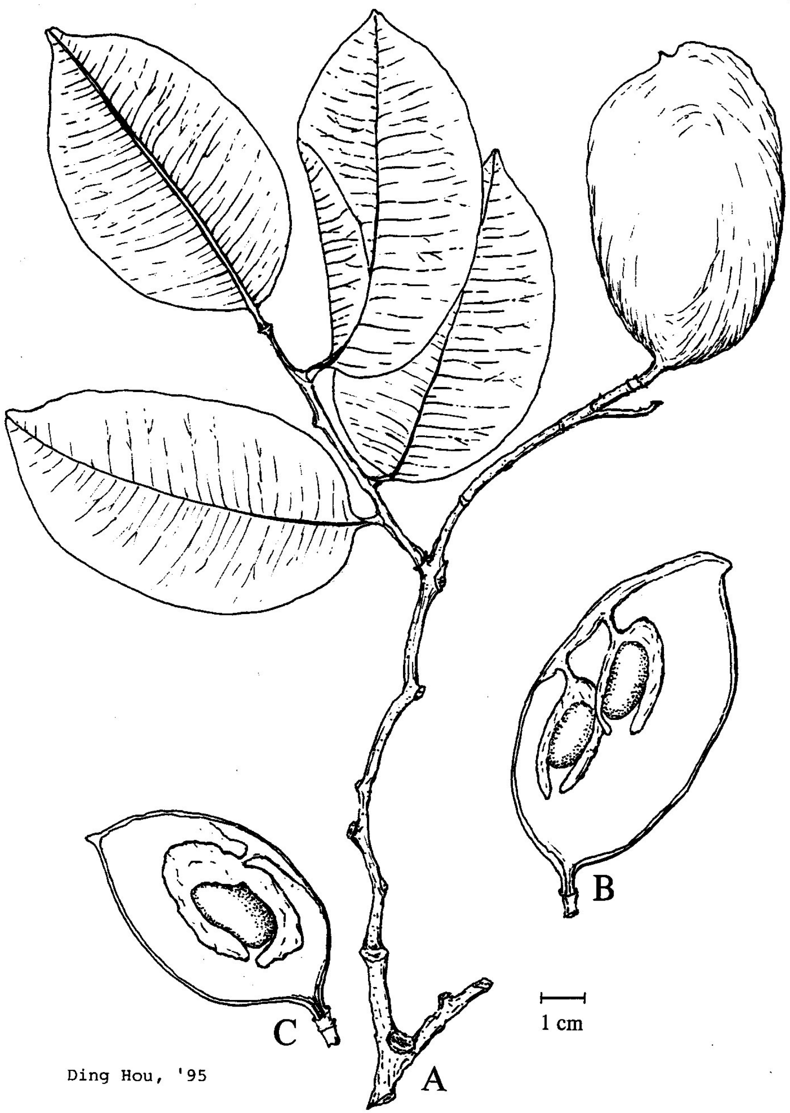

Fig. 3. *Copaifera palustris*. A, fruiting leafy twig; B and C, valves of two opened fruits showing one and two young arillate seeds respectively. (After FM 1, 12 (1996) 571, f. 24.)

4. **CRUDIA** Schreber, *nom. cons.*

(Dr. Crudy, collected plants before 1810 in Bahama Is., St. Thomas and St. Lucia, who communicated the specimen of the tree to Schreber)

Gen. 1 (1789) 282; Prain, J. As. Soc. Beng. 66, 2 (1897) 218; Ridley, FMP 1 (1922) 643; de Wit, Bull. Bot. Gard. Buitenz. 3, 18 (1950) 411; Backer & Bakhuizen *f.*, FJ 1 (1964) 527; Whitmore, TFM 1 (1972) 248; Cockburn, TS 1 (1976) 160; Anderson, CLST (1980) 233; Cowan & Polhill *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 131; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 198; Ding Hou, FM 1, 12 (1996) 573; Coode *et al.* (eds.), CLBD (1996) 162; Argent *et al*. (eds.), MNDT-CK 2 (1997) 353. **Synonym:** *Pryona* Miq., Fl. Ned. Ind. 1, 1 (1858) 1081.

Trees or shrubs, rarely scramblers. **Stipules** usually intrapetiolar, often connate at the basal parts, sometimes interpetiolar and free (in taxa outside Sabah and Sarawak), caducous or persistent. **Leaves** *compound*, *once pinnate and imparipinnate*, *each with 1–9(–13) leaflets*; *petiole and rachis often prolonged beyond the upper petiolule into a very short (deciduous) tip*. **Leaflets** alternate, very rarely opposite; *lateral veins ascending and archingly anastomosing towards the margins*; *intercostal venation often faintly*, *loosely reticulate*; petiolules short. **Inflorescences** axillary or terminal, *racemose*, solitary or fasciculate; bracts entire or lobed (sometimes 3-lobed with the central lobe redivided), often caducous, sometimes persistent; bracteoles 2, often minute, caducous; pedicel rather short. **Flowers** *bisexual*; hypanthium shortly cupular or campanulate; *calyx lobes 4*; *petals absent*; *stamens 10 or fewer*, filaments slightly equal or unequal in length, anthers small; *ovary* densely hairy, *1–6-ovuled*, style filiform, stigma terminal, small knob-like. **Fruits** (*pods*) *not winged*, obliquely orbicular, ellipsoid or ovoid, *compressed or somewhat swollen*, *dehiscing into 2 coriaceous or slightly woody valves*, *1–4(–6)-seeded*. **Seeds** suborbicular or subreniform, compressed, *without aril*; cotyledons concave.

Distribution. A tropical genus consisting of about 50 species distributed in America, Africa, Asia, and Malesia. Ten species occur in Sabah and Sarawak.

Ecology. In lowland forest, sometimes occurring up to 400 m altitude. De Wit (1950: 411) found that “the cotyledons are concave with a large inner cavity (also found, e.g., in *Entada*), which may cause buoyancy and promote dispersal”.

Key to *Crudia* species

1. Leaflets usually glabrous, rarely sparsely puberulous on the lower surface……...………2
   Leaflets pubescent to densely or minutely puberulous, rarely glabrescent and seemingly glabrous, on the lower surface...…………………………………………...………...5

2. Stipules falcate, 5–6 mm long. Bracts at the base of peduncle usually subulate and long-drawn, sometimes many, aggregate, and brush-like……….........…**5. C. reticulata**
   Stipules ovate, small or minute, up to 3.5 mm long. Bracts at the base of peduncle triangular, ovate to lanceolate or linear, not long-drawn or brush-like as above........…..3

3. Leaves each with 1 or 2 leaflets; petiole and rachis up to 1 cm long. Pedicel 2–4 mm long....……………………………………...……………....**6. C. subsimplicifolia**

Leaves each with 2–6(–8) leaflets; petiole and rachis 1.5–14 cm long. Pedicel usually 15–22 mm long...4

4. Leaves each with 4–6(–8) leaflets; petiole and rachis (6–)9–14 cm long. Fruits oblong, elliptic, or oblanceolate, 10–14 × 4.5–5 cm. Seeds irregularly suborbicular, 2.5–3 × 3.5–4 cm...**4. C. ornata**
Leaves each with 2–4 leaflets; petiole and rachis 1.5–7 cm long. Fruits ellipsoid or fusiform, 5–8 × 2.5–3.5 cm. Seeds transverse-oblong or slightly reniform, 2–2.2 × 3–3.7(–4.7) cm...**7. C. tenuipes**

5. Leaves each with (1–)2(–3) leaflets. Inflorescences or infructescences pendulous, up to 45 cm long...**1. C. bantamensis**
Leaves each with 2–8 leaflets. Inflorescences or infructescences erect, 4–15.5(–20) cm long...6

6. Leaves with petiole and rachis prolonged beyond the upper petiolule into a short tip...**2. C. beccarii**
Leaves with petiole and rachis not prolonged as above..................................7

7. Leaves with petiole and rachis 0.5–1 cm long...............................**8. C. velutina**
Leaves with petiole and rachis 1.5–10 cm long..8

8. Stamens alternately long and short..**9. C. venenosa**
Stamens almost equal in length...9

9. Leaves each with (4–)6–8 leaflets. Pedicel 10–15 mm long. Fruits elliptic, ovate-oblong or obovate, 7–10 × 2.5–3.5 cm, velvety..............................**3. C. caudata**
Leaves each with 3–5(–7) leaflets. Pedicel 3–4 mm long. Fruits ovate-oblong or broadly elliptic, 5–8 × 3.5–4.5 cm, short-hairy.......................................**10. C. wrayi**

1. **Crudia bantamensis** (Hassk.) Benth.
(of Bantam, Java)

Trans. Linn. Soc. 25 (1868) 315; Masamune *l.c.* 339; Fischer, Kew Bull. (1932) 73; de Wit *l.c.* (1950) 415; Backer & Bakhuizen *f. l.c.* 527; Ding Hou *l.c.* (1996) 577. **Basionym:** *Touchiroa bantamensis* Hassk., Retzia 1 (1885) 202. **Lectotype** (de Wit, 1950)**:** *Hasskarl s.n.* (Cult. in Hort. Bog. sub no. I-I-38, coll. in March 1925), Java, Bantam (holotype BO; isotype L). **Synonyms:** *Pryona bantamensis* (Hassk.) Miq., Fl. Ned. Ind. 1, 1 (1858) 1081; *Apalatoa bantamensis* (Hassk.) Baill., Hist. Pl. 2 (1869–70) 104.

Tree up to 16 m tall, 35 cm diameter. **Stipules** 3.5–4.5 mm long. **Leaves** *each with (1–)2(–3) leaflets* (usually one leaflet early shed and two persistent); petiole and rachis 0.5–2.5 cm long, prolonged beyond the upper petiolule into a very short tip. **Leaflets** glabrous above, *minutely*, *loosely*, *appressedly puberulous*, *glabrescent* (or almost glabrous except on the midrib) *beneath*; obovate-oblong or elliptic-oblong, or oblanceolate, 12–24 × 4–6.5(–9) cm, base acute, obtuse or rotundate, often symmetrical, apex acute, abruptly or gradually, shortly acuminate, sometimes rounded to subemarginate; lateral veins 5–7 per side; petiolules 1.5–5 mm, glabrous. **Inflorescences** axillary, *up to 45 cm long*, *pendulous*; rachis puberulous; bracts 2–3.5 mm long, ovate or triangular, or 3-lobed at about the upper 1/3 (the middle lobe redivided into a 3-pointed fork), puberulous, glabrescent; bracteoles 2, small, usually persistent; pedicel 1–2 mm long, articulated at the apex, puberulous. **Flowers** loosely puberulous outside, glabrescent, glabrous inside; hypanthium shortly cupular, *c.* 1.5 mm long; calyx lobes elliptic or ovate, 3–4 × 1.5–2 mm; stamens 8–10, filaments up to 12 mm long, glabrous; *ovary c.* 3 mm long, *3–5-ovuled*, style 6–8 mm long. **Fruits** oblong, ovate or broadly elliptic, 4–9 × 2–4 cm, *rugose*, slightly beaked, *dehiscing into 2 crooked*, *rather thin valves*, *1–4-seeded*. **Seeds** slightly reniform, or irregularly rounded, 3–3.75 × 1.75–3 cm, rather smooth.

Distribution. W Java (Bantam) and Borneo. In Sabah (once reported, Fischer, 1932); not yet found in Sarawak. Also in Kalimantan.

Ecology. In lowland forest, up to 400 m altitude, scattered, sometimes locally common. Flowering in January–February, July–September, and December; fruiting in July, September, and December.

2. **Crudia beccarii** Ridl.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Kew Bull. (1929) 257; de Wit *l.c.* (1950) 418; Anderson *l.c.* 233; Whitmore, Tantra & Sutisna *l.c.* 198; Ding Hou *l.c.* (1996) 579; Coode *et al.* (eds.) *l.c.* 162. **Type:** *Beccari PB 3903*, Borneo, Sarawak (holotype K; isotype FI).

Tree up to 25 m tall, 40 cm diameter. **Stipules** *c.* 3 mm long. **Leaves** *each with 3 or 4 leaflets*; *petiole and rachis* 1.5–3 cm long, *prolonged beyond the upper petiolule into a very short tip.* **Leaflets** glabrous above, *minutely appressedly hairy*, *sometimes glabrescent*, *or almost glabrous beneath*; obovate, obovate-oblong or elliptic-oblong, or elliptic, 6–14 × 2.5–5 cm, base obtuse or rounded, often symmetrical, *apex abruptly acuminate*; lateral veins 5–7 per side; petiolules *c.* 5 mm long, glabrous. **Inflorescences** axillary or terminal, *up to 14 cm long*, *erect*; bracts triangular or subulate, 0.75–4 mm long, puberulous outside; bracteoles 2, minute, triangular, *c.* 0.5 mm long; pedicel 2–3 mm long, articulated at the base. **Flowers** slightly puberulous outside; hypanthium *c.* 1 mm long, glabrous inside; calyx lobes ovate, broadly elliptic or slightly obovate, 3–3.5 × 2 mm, glabrous inside; stamens (9 or)10, filaments 5–7 mm long; *ovary 4(–6)-ovuled*. **Fruits** broadly ellipsoid or slightly obovoid, 3.5–4.3 × 2.5 cm, flattened. **Seeds** subreniform, *c.* 1.5 × 2.5 cm.

Distribution. Endemic to Borneo. In Sarawak, so far known only from two collections: *Beccari PB 3351 and PB 3903*, without precise localities; not yet reported in Sabah. Also in Brunei and Kalimantan.

Ecology. In lowland forest, up to 50 m altitude. Flowering in July, fruiting in October.

3. **Crudia caudata** Prain

(Latin, *caudatus* = tail-shaped; the leaf apex)

J. As. Soc. Beng. 66, 2 (1897) 219 & 488; Merrill *l.c.* (1921) 296; Ridley *l.c.* (1922) 644; Masamune *l.c.* 339; de Wit *l.c.* (1950) 422; Whitmore *l.c.* 249; J.E. Vidal, Fl. Thail. 4 (1984) 92; Whitmore, Tantra & Sutisna *l.c.* 198; Turner, *l.c.* 298; Ding Hou *l.c.* (1996) 581. **Type:** *Ridley 6399*, Peninsular Malaysia, Johore (holotype K, isotype BM). **Synonym:** *C. bracteolosa* de Wit *l.c.* (1950) 421.

Tree up to 25 m tall. **Bark** grey-brown, only slightly peeling, *c.* 7 mm thick, red-brown but inside dull yellow. **Stipules** triangular to lanceolate, up to 7(–13) mm long. **Leaves** *each with (4–)6–8 leaflets*; *petiole and rachis up to 10 cm long*, *not prolonged into a short tip*. **Leaflets** glossy and glabrous above, *rusty pubescent beneath*; elliptic-oblong or obovate-oblong, 7–9(–15) × 2–3(–4) cm, base obtuse, rounded, or cuneate, symmetrical, *apex acuminate or caudate*; lateral veins 5–8 per side; petiolules 1–2 mm long. **Inflorescences** axillary or terminal, usually *erect*, *up to 15 cm long*; rachis rusty tomentose, rather densely flowered; *bracts* ovate to lanceolate, sometimes oblanceolate, (5–)7–9 mm long, pubescent outside and glabrous inside, *some of them 3-lobed and the central lobe imparipinnately relobed*; *bracteoles lanceolate or spoon-shaped*, 6–9 mm long, *almost enclosing the bud*; *pedicel 10–15 mm long*, pubescent, articulated at the apex. **Flowers** pubescent outside; hypanthium 2–2.5 mm long; calyx lobes ovate, unequally sized, 5–7 × 3.5–5 mm, glabrous inside; stamens 10, or rarely 9, *filaments almost equal in length*, up to 15 mm long; *ovary (4–)6-ovuled*, style 8–17 mm long. **Fruits** (unripe) *elliptic*, *ovate-oblong*, *or obovate*, *7–10 × 2.5–3.5 cm*, *flat*, *rusty*, *velvety*, *usually 1-seeded*, valves thin-coriaceous. **Seeds** shortly oblong, broadly elliptic, or rounded, flat, 3–4 × 2–3 cm.

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Sarawak (no precise localities) known from the following collections: *Beccari PB 1763 and PB 3711*; *Foxworthy 306*; not yet found in Sabah. Also in Brunei and W Kalimantan.

Ecology. In riverine and freshwater swamp forest, at low altitude. Fruiting in June–July.

4. **Crudia ornata** de Wit Fig. 4.

(Latin, *ornatus* = adorned or embellished; inference unknown)

Bull. Bot. Gard. Buitenz. 3, 18 (1950) 425; Cockburn *l.c.* 160; Whitmore, Tantra & Sutisna *l.c.* 199; Ding Hou *l.c.* (1996) 587; Argent *et al.* (eds.) *l.c.* 352. **Type:** *Elmer 20708*, Borneo, Sabah, near Tawau (holotype BO; isotypes BM, K, L). **Synonym:** *C. reticulata auct. non* Merr. (1918): Merrill *l.c.* (1929) 99.

Tree up to 20 m tall, 30 cm diameter, occasionally as shrub-like tree or treelet up to 1.5 m high. **Stipules** *ovate*, *2–3 mm long*. **Leaves** *each with 4–6(–8) leaflets*; *petiole and rachis (6–)9–14 cm long*, minutely puberulous. **Leaflets** glabrous above, *rarely minutely puberulous*, *glabrescent*, *or glabrous beneath*; elliptic-oblong, obovate-oblong or ovate-oblong, or elliptic, (7.5–)14–20 × (3.5–)4.8–7.5 cm, base cuneate, acute, obtuse, or rounded, symmetrical, *apex cuspidate or rather abruptly acuminate*; lateral veins 5–8 per side; petiolules 5–9 mm long. **Inflorescences** axillary, sometimes also terminal, up to 15.5 cm long, erect; rachis tomentose; *bracts triangular*, *ovate*, *lanceolate*, *or linear*, 10–15 mm long, puberulous, glabrescent; *bracteoles elliptic*, *lanceolate*, *or oblanceolate*, 6–8 mm long, *often at the upper half of pedicel*, *covering the bud at its very young stage*; *pedicel 15–20 mm long*, puberulous. **Flowers** puberulous outside; hypanthium 2–3 mm long, glabrous inside; *calyx lobes unequal*, broadly elliptic or elliptic, or obovate, 6–

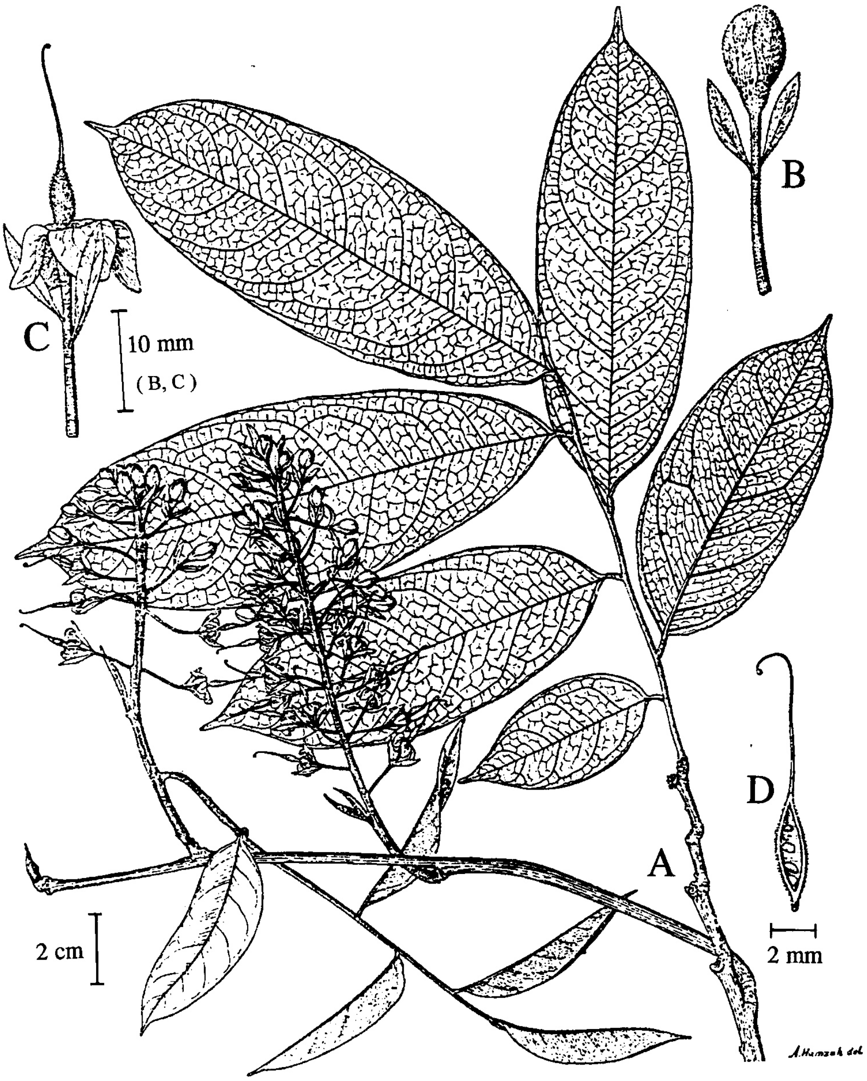

Fig. 4. *Crudia ornata*. A, flowering leafy twig; B, flower bud with bracteoles; C, flower, with stamens removed; D, pistil, with ovary in longitudinal section. (After FM 1, 12 (1996) 586, f. 27.)

7 × 3–4 mm, slightly loosely, appressedly puberulous often on the lower half inside, glabrescent, or almost glabrous; stamens 10(or 9), filaments up to 15 mm long, glabrous; *ovary (4–)6-ovuled*, style up to 8 mm long. **Fruits** *oblong*, *elliptic*, *or oblanceolate*, *10–14 × 4.5–5 cm*, shortly hairy, *1–several-seeded*, valves hard, coriaceous. **Seeds** *irregularly suborbicular* or subreniform, *2.5–3 × 3.5–4 cm*, slightly finely rugose.

Vernacular names. Sabah—*kelat* (Malay, Timbun Mata Is.), *sansag* (Kinabatangan).

Distribution. Endemic to Borneo. In Sabah known from Sandakan, Kota Kinabalu, Tenom, Labuk Sugut, Kinabatangan, Semporna (Timbun Mata Is.), and Tawau districts. In Sarawak recorded from the 5th Division. Also in Kalimantan.

Ecology. In primary forests, from lowland up to 200 m altitude, sometimes occurring on sandy soils and limestone. Flowering in January–February, April, July–August, and November; fruiting in April and July–August.

5. **Crudia reticulata** Merr.

(Latin, *reticulatus* = reticulate; the intercostal venation of the leaflets)

Philip. J. Sci. 13 (1918) 73, *l.c.* (1921) 296; Masamune *l.c.* 340; de Wit *l.c.* (1950) 426; Cockburn *l.c.* 160; Anderson *l.c.* 233; Whitmore, Tantra & Sutisna *l.c.* 199; Ding Hou *l.c.* (1996) 589; Argent *et al.* (eds.) *l.c.* 353. **Type:** *Villamil 393*, Borneo, Sabah, Sandakan (isotype K).

Tree up to 18 m tall, 20 cm diameter, sometimes shrub-like up to 4 m tall, rarely a climber (?). **Stipules** *falcate*, *5–6 mm long*, caducous. **Leaves** *each with (1–)2–3(–4) leaflets*; petiole and rachis 0.5–2(–4) cm long. **Leaflets** *glabrous or rarely sparsely minutely hairy below*; elliptic, elliptic-oblong, ovate-oblong or obovate-oblong, 10–29(–36) × 3–8(12.5) cm, base cuneate, acute, obtuse, or rounded, symmetrical or slightly asymmetrical, *apex acuminate or rather abruptly caudate-acuminate*, acumen slender, 1.5–2.5(–3.5) cm long; lateral veins 5–9 (or more) per side; petiolules 3–7 mm long. **Inflorescences** axillary, up to 10(–28) cm long, rachis puberulous; *bracts subulate and long-drawn*, *or 3-lobed with the central lobe divided again and bristle-like*, slightly hairy, up to 8 mm long, *sometimes many*, *aggregate*, *surrounding the base of the peduncle and brush-like*, (semi-) persistent, puberulous outside, slightly ciliate on the margins, those at the base of pedicel rather small, triangular, 0.3–1.5 mm long; bracteoles minute; pedicel 3–5 mm long. **Flowers** puberulous outside, glabrous inside; hypanthium *c.* 1 mm long; calyx lobes ovate or broadly ovate, 3.5–4 × 2–2.5 mm; stamens (8–)10, filaments usually 4–6 mm long; *ovary usually 4-ovuled*, style 4.5–5.5(–10) mm long. **Fruits** (young) ellipsoid or ovoid, 8.5–12.5 × 3–4 cm, densely shortly hairy. **Seeds** broadly ellipsoid or suborbicular, 2.6–3.3 × 2–2.4 cm; *testa rusty scurfy*, *finely rugose*.

Vernacular names. Sabah—*angar-angar* (preferred name), *maguwau* (Dusun, Lahad Datu), *selangapid* (Sandakan), *tanggar-angor* (Kinabatangan).

Distribution. Endemic to Borneo. In Sabah known for Sandakan (Sepilok), Lahad Datu, Kinabatangan (Lamag) and Tawau districts. In Sarawak recorded for northern region, Bintulu and Tatau districts. Also in Kalimantan.

Ecology. In lowland primary mixed dipterocarp, periodically inundated freshwater swamp and peatswamp forests on sandy, loamy soils with coral limestone, occasionally in secondary forest, up to 250 m, once recorded at 1000 m altitude (Berau, Kalimantan). Flowering in January–April and July–September; fruiting in April and June–October.

6. **Crudia subsimplicifolia** Merr.

(Latin, *sub-* = somewhat, *simplici-* = simple, *-folius* = -leaved; tree with somewhat simple leaves)

Philip. J. Sci. 5 (1910) Bot. 39; de Wit *l.c.* (1950) 431; Ding Hou *l.c.* (1996) 592. **Type:** *Klemme FB 4287*, the Philippines, Luzon (isotype K).

Tree up to 15 m tall, 40 cm diameter. **Stipules** *ovate*, *c. 3.5 mm long*, caducous. **Leaves** *each with 1 or 2 leaflets*, when 2 never opposite; *petiole and rachis up to 1 cm long*. **Leaflets** *glabrous or rarely sparsely minutely hairy below*; elliptic, elliptic-oblong or obovate-oblong, or lanceolate, 9.5–21(–29) × 3.5–7(–9) cm, base acute or obtuse, symmetrical, *apex shortly acuminate or acuminate*; lateral veins 6–9 per side; petiolules 2–3.5 mm long. **Inflorescences** axillary or sometimes terminal, up to 11(–16) cm long, glabrous; *bracts triangular or 3-lobed with the central lobe relobed and bristle-like*, up to 5 mm long, glabrous except ciliate at the margins; bracteoles often at the lower half or at the base of the pedicel, minute; *pedicel 2–4 mm long*, glabrous. **Flowers** glabrous outside except ciliate at the margins of the calyx lobes; hypanthium *c.* 1 mm long, sparsely hairy inside; calyx lobes ovate or broadly elliptic, *c.* 4 × 2.5–3 mm, glabrous inside; stamens 10, filaments 4–6 mm long; *ovary 3–4-ovuled*, style up to 10 mm long. **Fruits** (very young) elliptic, *c.* 0.6 × 0.3 cm.

Vernacular names. Sabah—*maid maid*, *sarason* (Lahad Datu).

Distribution. Borneo, the Philippines and Aru Is. In Sabah known in Kinabatangan (Pin R. and Tongod), Sandakan, Keningau, Lahad Datu, Semporna, Tawau, and Tenom districts. In Sarawak recorded for the 3rd Division. Also in E Kalimantan.

Ecology. In primary mixed dipterocarp forest on ridges, low undulating lands, or near the rivers, up to 300(–900) m altitude. Flowering in January–April, June, and October; fruiting in April.

7. **Crudia tenuipes** Merr.

(Latin, *tenui-* = slender, thin, *pes* = foot; flower with slender pedicel)

Philip. J. Sc. 11 (1916) Bot. 83, *l.c.* (1921) 296; Masamune *l.c.* 340; de Wit *l.c.* (1950) 430; Cockburn *l.c.* 160; Anderson *l.c.* 233; Whitmore, Tantra & Sutisna *l.c.* 199; Ding Hou *l.c.* (1996) 593; Coode *et al.* (eds.) *l.c.* 162; Argent *et al.* (eds.) *l.c.* 354. **Type:** *Native Collector* (Bur. Sci.) *1358* (err. as 1385), Borneo, Sarawak (isotype K).

Tree up to 27 m tall, 40 cm diameter; buttresses steep, up to 1.5 m high and 30 cm extending outwards from the base. **Stipules** *ovate*, *minute*, caducous. **Leaves** *each with 2–4 leaflets*; *petiole and rachis 1.5–7 cm long*. **Leaflets** *glabrous on both surfaces*; elliptic-oblong or ovate-oblong, 7–20 × 3–7 cm, base cuneate, acute, obtuse, or rounded, symmetrical or slightly asymmetrical, *apex acuminate or rather abruptly acuminate*; lateral veins 5–7 per side; petiolules *c.* 5 mm long, glabrous. **Inflorescences** axillary, up to 24 cm long, glabrous; *bracts triangular*, up to 1.5 mm long, glabrous, caducous; bracteoles minute, caducous; *pedicel (7–)15–22(–30) mm long*, glabrous. **Flowers** glabrous outside; hypanthium *c.* 2 mm long; calyx lobes elliptic or ovate-oblong, 4–4.5 × 2–2.5 mm, inner surface often puberulous on the vertical, central part, glabrescent, sometimes almost glabrous; stamens (8–)10, filaments up to 12 mm long, glabrous; *ovary (2–)4(–5)-ovuled*, style up to 14 mm long. **Fruits** *ellipsoid or fusiform*, *5–8 × 2.5–3.5 × 1.8–2.5 cm*, swollen, gradually narrowed from the middle towards both ends, shortly hairy, *1–2(–more)-seeded*; valves coriaceous, hard. **Seeds** *transverse-oblong* or *slightly reniform*, *2–2.2 × 3–3.7 (–4.7) × 1.8–2.3 cm*, slightly swollen, smooth, shining.

Distribution. Endemic to Borneo. In Sabah known in Sandakan, Beaufort, Kota Kinabalu, Lahad Datu, Tenom, and Tawau districts. In Sarawak recorded for Kapit, Kuching, Marudi (Mt. Dulit), and Miri districts. Also in Brunei and Kalimantan.

Ecology. Widespread in forests; sometimes found on limestone, coral rock, sandy yellow loam soils. From lowland up to 500 m altitude. Flowering in February–May, and October–November; fruiting in April–May, July–September, and December.

8. **Crudia velutina** Ridl.

(Latin, *velutinus* = velvety; some parts of the plant covered with fine short hairs)

Kew Bull. (1929) 257; de Wit *l.c.* (1950) 432; Whitmore *l.c.* 252; Anderson *l.c.* 233; Whitmore, Tantra & Sutisna *l.c.* 199; Turner *l.c.* 299; Ding Hou *l.c.* (1996) 594. **Type:** *Haviland 3071*, Borneo, Sarawak, Sri Aman district (holotype K; isotypes BM, L).

Tree up to 30 m tall, 70 cm diameter; buttresses up to 2.4 m high. **Bark** smooth to dippled; inner bark brown, laminated. **Sapwood** yellowish brown. **Stipules** *subulate*, *2–3 mm long*, deciduous. **Leaves** *each with 2–3(–4) leaflets*; *petiole and rachis 0.5–1 cm long*, brown puberulous, glabrescent. **Leaflets** upper surface puberulous when young, glabrescent, or almost glabrous when old, *lower surface* glaucous, *finely*, *uniformly*, *appressedly*, *rather densely puberulous (when young)*; obovate, obovate-oblong or elliptic-oblong, or elliptic, 8.5–13.5(–18) × 3.5–6(–8) cm, base obtuse or rounded, often symmetrical, *apex shortly bluntly acuminate*, *or acuminate*; lateral veins *c.* 5 per side; petiolules *c.* 5 mm long. **Inflorescences** axillary or terminal, *up to 12 cm long*, *erect*; rachis densely puberulous; bracts small, triangular, *c.* 1 mm long, puberulous outside, ciliate on the margins; bracteoles minute; flowers subsessile or pedicel 1–2 mm long. **Flowers** minutely, appressedly puberulous outside; hypanthium *c.* 1 mm long, glabrous inside; *calyx lobes* ovate or elliptic, 3–5 × 2–2.5 mm, *glabrous inside*, ciliate on the margins; stamens (9 or)10, filaments 3–7(–10) mm long; *ovary (3–)4(–5)-ovuled*, style 6–7 mm long. **Fruits** not seen.

Distribution. Peninsular Malaysia and Borneo. In Sarawak known only from Bt. Kalong in Sri Aman district; not yet found in Sabah.

Ecology. In forests on undulating lands, a few meters above sea level. Flowering in April and May.

9. **Crudia venenosa** de Wit

(Latin, *venenosus* = poisonous; poisonous plant)

Bull. Bot. Gard. Buitenz. 3, 18 (1950) 433; Whitmore, Tantra & Sutisna *l.c.* 199; Ding Hou *l.c.* (1996) 595. **Type:** *Maidin* (*SAN A*) *1692*, Borneo, Sabah, Sg. Kinabatangan (holotype BO; isotype K).

Tree up to 8 m tall. **Stipules** caducous. **Leaves** *each with 4–6 leaflets*; *petiole and rachis 6.5–10 cm long*, or longer. **Leaflets** glabrous above, *sparsely minutely puberulous below*; elliptic, elliptic-oblong or obovate-oblong, 11–18 × 5–6.8 cm, base rounded, symmetrical, *apex abruptly shortly acuminate*; lateral veins 5–8 per side; petiolules distinct, *c*. 7 mm long. **Inflorescences** axillary or terminal, *erect*, *up to 10 cm long*; rachis puberulous; bracts triangular, 0.5–2.5 mm long, glabrous except ciliate at the margins; bracteoles minute; pedicel 2–6 mm long. **Flowers** puberulous outside; hypanthium 1–2 mm long; calyx lobes elliptic or ovate, 3–4 × 2 mm; *stamens 10*, *alternately long and short*; ovary 3–4-ovuled. **Fruits** not seen.

Vernacular name. Sabah—*sansag* (Kinabatangan).

Distribution. Endemic to Borneo. In Sabah known only by the type collection from Sg. Kinabatangan; not yet found in Sarawak.

Ecology. In swamp forest. Flowering in March.

10. **Crudia wrayi** Prain

(L. Wray, Jr., 1853–1942, sometime Superintendent of the Larut Hill Garden at Taiping, Curator of the Perak State Museum, and Director of Museums of the Federated Malay States)

J. As. Soc. Beng. 66, 2 (1897) 222 & 488; Ridley *l.c.* (1922) 646; Whitmore *l.c.* 252; Anderson *l.c.* 233; Whitmore, Tantra & Sutisna *l.c.* 199; Turner *l.c.* 299; Ding Hou *l.c.* (1996) 596. **Type:** *Wray Jr. 2874*, Peninsular Malaysia, Perak, Larut (holotype K). **Synonym:** *C. havilandii* Prain, J. As. Soc. Beng. 73, 2 (1904) 199, de Wit *l.c.* (1950) 423.

Tree up to 32 m tall, 45 cm diameter, with fluted bole; buttresses steep up to 3.6 m high, 300 cm wide, 5 cm thick. **Bark** greyish brown, smooth to flaky; inner bark light brownish green. **Stipules** lanceolate, 2–3.5 mm long, deciduous. **Leaves** *each with 3–5(–7) leaflets*; *petiole and rachis 1.5–4(–6.5) cm long*, loosely puberulous, glabrescent, or glabrous. **Leaflets** sparsely puberulous or glabrous above, *loosely, minutely puberulous beneath*; elliptic, ovate-elliptic or obovate-elliptic, (3.5–)5.5–13 × (1.3–)2.5–5 cm, base obtuse, or cuneate, symmetrical, *apex acuminate or caudate*; lateral veins 4–8 per side; petiolules 2–5 mm long. **Inflorescences** axillary or terminal, *up to 9(–20) cm long*, *erect*; rachis puberulous; *bracts deltoid or 3-lobed*, up to 4 mm long, sparsely puberulous outside, caducous; bracteoles minute; *pedicel 3–4 mm long*. **Flowers** sparsely puberulous outside; hypanthium *c*. 0.6 mm long, glabrous inside; *calyx lobes unequal*, broadly elliptic, elliptic, or oblong, 3.5–4 × 2.5–3 mm, *glabrous inside*; stamens (8–)10, *filaments almost equal in length*, up to 11 mm long; *ovary c*. 3.5 mm long, *2(–4)-ovuled*, style *c*. 8 mm long, glabrous. **Fruits** *ovate-oblong or broadly elliptic*, *5–8 × 3.5–4.5 cm*, *short-hairy*, *1 (–more)-seeded*. **Seeds** broadly obovate, *c.* 3.5 × 2.5 cm.

Distribution. Peninsular Malaysia and Borneo. In Sarawak known from Kuching district; not yet found in Sabah. Also in Kalimantan.

Ecology. In primary lowland mixed dipterocarp forest, riverine and swamp forest, and once recorded at the base of limestone hill at Bau (near Kuching), up to 90 m altitude. Flowering in September–October and December; fruiting in January, March and September.

5. **CYNOMETRA** L.

(Greek, *kuon* = dog, *metra* = female genitalia; referring to the shape of the fruit)

katong-katong, *kekatong* (Malay)

Sp. Pl. (1753) 382; Prain, J. As. Soc. Beng. 66, 2 (1897) 196; Ridley, FMP 1 (1922) 635; Backer & Bakhuizen *f.*, FJ 1 (1964) 525; Knaap-van Meeuwen, Blumea 18 (1970) 12; Whitmore, TFM 1 (1972) 253; Cockburn, TS 1 (1976) 160; Verdcourt, Lae Bot. Bull. 11 (1979) 77; Anderson, CLTS (1980) 233; Cowan & Polhill *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 124; Corner, WSTM 3rd. edition 1 (1988) 433; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 200; Ding Hou, FM 1, 12 (1996) 597; Loo & Tan, Gard. Bull. Sing. 49, 1 (1997) 72; Argent *et al*. (eds.), MNDT-CK 2 (1997) 354.

Trees or shrubs. *Buds* small, *with numerous brown scales in two ranks*. *New leaves developing in bright pink tassels*. **Stipules** caducous. **Leaves** *compound*, *once pinnate and paripinnate*, *each with 1 or 2 pairs of asymmetrical leaflets*. **Leaflets** *opposite*, *asymmetrical*, entire and mostly glabrous. **Inflorescences** axillary, paniculate, racemose, or spike-like, solitary or sometimes 2 per axil, rarely borne on older branches and stems and fasciculate, mostly spherical in outline, sometimes elongated, sessile, densely flowered; *bracts scale-like*, *mostly persistent*, appressed hairy, often glabrescent. **Flowers** *bisexual*; hypanthium usually shortly campanulate, sometimes obscure or absent; *calyx lobes 4(–5)*; *petals 5(or 4)*, glabrous; *fertile stamens (8–)10(–15)*, *equal in length*, filaments free, rarely united at the base, usually glabrous; *ovary 1–2(–4)-ovuled*. **Fruits** usually thickened, *broad ovoid or broad ellipsoid*, *less than 8 cm long*, *indehiscent*, often flattened especially when young, *smooth or rugose*, sometimes warty, *1(–4)-seeded*. **Seeds** without endosperm.

Distribution. A pantropical genus comprising about 70 species; 3 species in Sabah and Sarawak.

Ecology. In forests, sometimes growing on banks of rivers or streams, or in coastal areas, from lowland up to 1300 m altitude.

Key to *Cynometra* species

1. Leaves with only 1 pair of leaflets. Rachis of inflorescence *c.* 4.5 cm long........**1. C. elmeri**
   Leaves with 1 or 2 pairs of leaflets. Rachis of inflorescence less than 4 cm long………....2

2. Inflorescences borne on the trunk; pedicel of flowers 7–15 mm long. Fruits deeply rugose……………………………………………………………………**3. C. ramiflora**
   Inflorescences axillary; pedicel of flowers 18–26 mm long. Fruits smooth……………………………………………………………………………………**2. C. mirabilis**

1. **Cynometra elmeri** Merr. Fig. 5A–B.

(A.D.E. Elmer, 1870–1942, plant collector in the Philippines and Borneo)

PEB (1929) 98; Knaap-van Meeuwen *l.c.* 29; Meijer, Field Guide Tree W. Mal. (1974) 181; Cockburn *l.c.* 162; Whitmore, Tantra & Sutisna *l.c.* 200; Ding Hou *l.c.* (1996) 602. **Type:** *Elmer 21386* (err. as '21368'), Borneo, Sabah, Tawau (isotypes L, U).

Tree up to 25 m tall. **Leaves** *each with 1 pair of leaflets*; petiole 0.4–0.8 cm long. **Leaflets** ovate-oblong or oblong, more or less falcate, 3.5–15 × 1.3–4 cm, base cuneate, *apex acuminate*, *acumen blunt and emarginate*; lateral veins 5–7 pairs. **Flowers** unknown. *Rachis of infructescence c. 4.5 cm long*. **Fruits** *pendulous*, flat, 4–6 × 2.5–3.5 cm, *inner suture more or less straight*, *outer suture widely curved*, with a small beak on the inner suture side of the apex, *surface rough*.

Distribution. Borneo and the Philippines. In Sabah found in Tawau and Kinabatangan districts, not yet reported in Sarawak.

Ecology. In back mangrove and freshwater swamp forests, up to 300 m altitude.

2. **Cynometra mirabilis** Meeuwen Fig. 5C–D.

(Latin, *mirari* = wonderful, extraordinary; inference unknown)

Blumea 18 (1970) 25; Cockburn *l.c.* 162; Whitmore, Tantra & Sutisna *l.c.* 200; Ding Hou *l.c.* (1996) 605. **Type:** *Miranda FB 20528*, the Philippines (holotype L; isotypes BO, UC, US).

Tree up to 35 m tall, 80 cm diameter. **Bark** pale yellow-grey, smooth, later lenticellate; inner bark pink-brown, thin. **Leaves** *each with 1 or 2 pairs of leaflets*. **Leaflets** (ob)ovate-oblong to elliptic or oblong, 6.5–12.5 × 3–5 cm, base cuneate, *apex acuminate*, *sometimes slightly emarginate*; midrib 10–18 mm from the upper margins; lateral veins *c.* 7 pairs; petiole 5–10 mm long. **Inflorescences** *axillary*, *rachis 0.6–1 cm long*, glabrous or with a few hairs; bracts up to 11 mm long; *pedicel 18–26 mm long*, glabrescent. **Flowers:** hypanthium 1–1.5 mm long; *calyx lobes* 5–6 mm long, *glabrous*; petals *c.* 7 mm long; stamens occasionally with a few hairs; *ovary woolly or only with a few hairs outside*, *inside wall lined with curly appressed hairs*. **Fruits** (immature) obovoid, 3 × 1.7 × 0.2 cm, *smooth*.

Vernacular name. Sabah—*katong-katong* (preferred name).

Distribution. Borneo and the Philippines. In Sabah known from Sandakan, Lahad Datu, Semporna, Tawau, Kinabatangan, and Kudat (Banggi Is.) districts; not known in Sarawak.

Ecology. Often found in inland forest, also occurring near the seashore or along rivers, up to 150(–600) m altitude. Flowering in May, August and October; fruiting in April.

3. **Cynometra ramiflora** L. Fig. 5E–F.

(Latin, *ramus* = branch, *flos* = flower; flowers borne on branches)

Sp. Pl. (1753) 382, *excl. syn. Iripa* Rheede; Prain *l.c.* (1897) 197; Merrill, Int. Rumph. Herb. Amb. (1917) 254; Ridley *l.c.* (1922) 635; Browne, FTSB (1955) 223); Backer & Bakhuizen *f. l.c.* 526; Knaap-van Meeuwen *l.c.* 23; Whitmore *l.c.* 254; H. Keng *l.c.* (1974) 258; Cockburn *l.c.* 162; Verdcourt *l.c.* 82; Anderson *l.c.* 233; K. Larsen & S.S. Larsen *l.c.* (1980) 118, *l.c.* (1984) 48; Corner *l.c.* 434; Keng *l.c.* (1990) 34; Whitmore, Tantra & Sutisna *l.c.* 200; Turner *l.c.* 299; Ding Hou *l.c.* (1996) 606; Argent *et al.* (eds.) *l.c.* 354. **Type:** *Cynomorium sylvestre* Rumph., Herb. Amb. 1 (1741) *t.* 63. **Synonym:** *C. bijuga* Span. *ex* Miq., Fl. Ind. Bat. 1, 1 (1855) 78, Merrill *l.c.* (1921) 295, Masamune *l.c.* 340.

Distribution. A species consisting of two varieties distributed in India, throughout SE Asia and Malesia to the Pacific. In Sabah and Sarawak only var. *ramiflora* is known. Another one, var. *bifoliolata* (Merr.) Meeuwen, occurs in the Philippines.

var. **ramiflora**

Ding Hou, FM 1, 12 (1996) 606; Loo & Tan *l.c.* 73. **Synonyms:** *C. ramiflora* L., Sp. Pl. (1753) 382, *excl. syn. Iripa* Rheede; *C. bijuga* Span. *ex* Miq., Fl. Ned. Ind. 1, 1 (1855) 78, Merrill *l.c.* (1921) 295; *C. whitfordii* Elmer, Leafl. Philipp. Bot. 8 (1915) 2734.

Tree up to 26 m tall. **Leaves** *each with 1 and/or 2 pairs of leaflets*, rarely with 2 pairs only; petiole 0.3–1.5 cm long, rachis 1.5–4 cm long, both sometimes patent-hairy, glabrescent, or glabrous. **Leaflets** ovate, ovate-oblong, oblong, elliptic, lanceolate, rarely orbicular, (1.2–)4.5–(6.5–)20 × (0.5–)2.5–(3.5–)7 cm, base cuneate, *apex acute or acuminate*; lateral veins (4–)8–16 pairs; petiolules indistinct. **Inflorescences** *borne on the trunks*, *1.3–2.5 cm long*, usually glabrescent, sometimes glabrous; *pedicel 7–15 mm long*. **Flowers:** hypanthium 1–1.25 mm long; calyx lobes 4–6 mm long; petals lanceolate, 5–8 mm long; stamens 10; *ovary densely*, *often curly hairy*, *1(–2)-ovuled*. **Fruits** *broadly ovoid or broadly ellipsoid*, *the tip pointing up*, *thick-woody*, *deeply rugose*, *shortly brown scurfy*, 2.2–5 × 1.3–4 cm.

Vernacular name. Sabah—*katong-katong* (preferred name).

Distribution. From India throughout SE Asia and Malesia to the Pacific. In Sabah in coastal area and Mt. Silam in Lahad Datu district; in Sarawak throughout.

Ecology. In forest just behind mangrove; also occurring in inland forests, up to 400 m altitude.

Uses. The dark brown timber is heavy and hard but not very durable. It is only available in small quantity and is used in local construction.

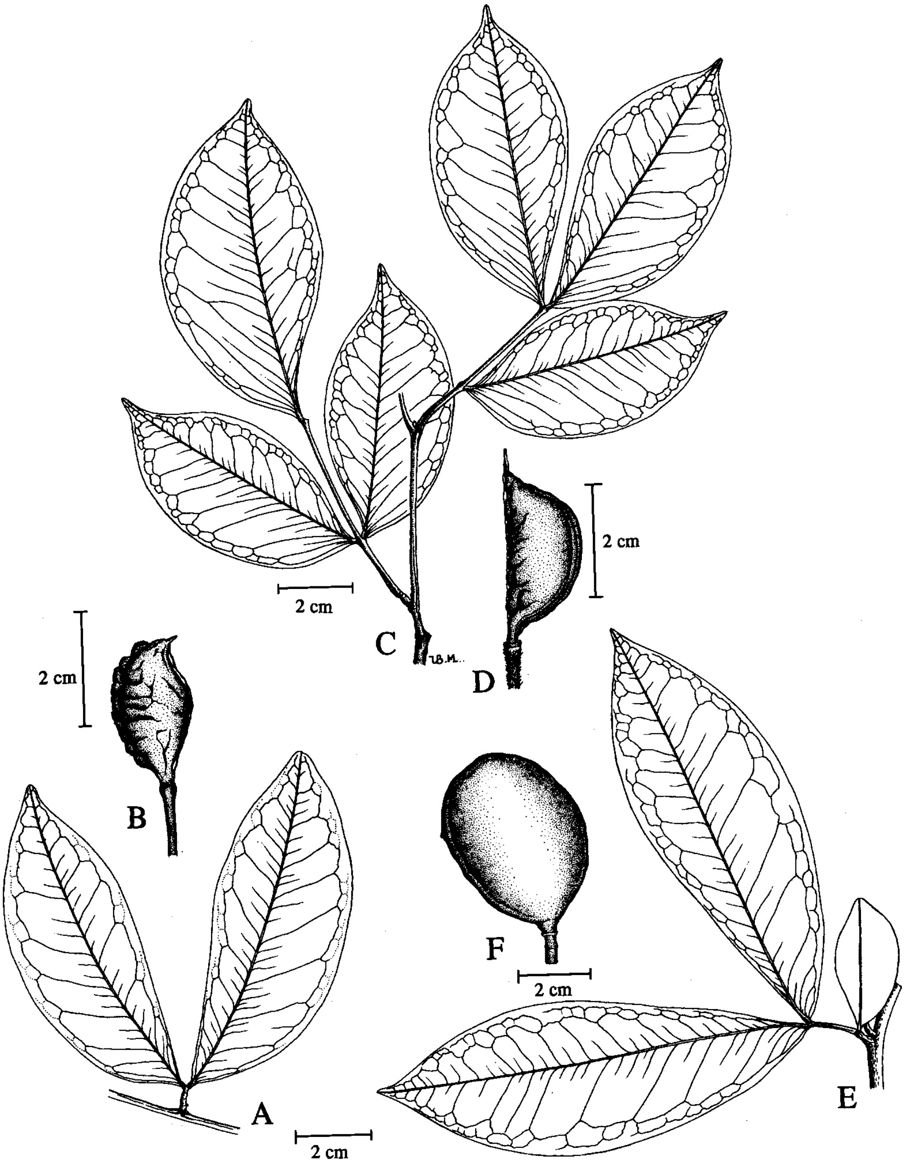

Fig. 5. *Cynometra elmeri* (A–B), *C. mirabilis* (C–D), *C. ramiflora* (E–F). A, C and E, leafy twigs; B, D and F, fruits. (A–B from *Ignasius & Clement SAN 139763*, C–D from *Nordin SAN 46321*, E–F from *Sugau et al. JBS 176*.)

6. **DIALIUM** L.

(Latinised old Greek plant name *dialion*, used for a kind of heliotrope)

keranji (Malay)

Mant. 1 (1767) 3; Prain, J. As. Soc. Beng. 66, 2 (1897) 167; Ridley, FMP 1 (1922) 621; Backer & Bakhuizen *f.*, FJ 1 (1964) 535; Whitmore, TFM 1 (1972) 255; Cockburn, TS 1 (1976) 164; Anderson, CLTS (1980) 233; Irwin & Barneby *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 101; Corner, WSTM 3rd. edition 1 (1988) 436; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 200; Rojo, FM 1, 12 (1996) 608; Coode *et al.* (eds.), CLBD (1996) 162; Loo & Tan, Gard. Bull. Sing. 49, 1 (1997) 75; Argent *et al.* (eds.), MNDT-CK 2 (1997) 354. **Synonyms:** *Dansera* Steenis, Bull. Bot. Gard. Buitenz. 3, 17 (1948) 413; *Dialium* subgen. *Dansera* (Steenis) Steyaert, Reinwardtia 2 (1953) 355.

Trees; bole columnar, often slightly twisted especially above; buttresses steep, plank-like spreading. **Bark** usually pale brown or grey, often rugose. **Stipules** small, caducous. **Leaves** *compound*, *once pinnate and imparipinnate*, *each with (1–)3 or more leaflets, rarely unifoliolate*. **Leaflets** shortly stalked, often alternate, entire, more or less glabrous above, glabrous or velvety beneath. **Inflorescences** terminal or axillary *panicles*, *often in fascicles*, usually hairy. **Flowers** *bisexual*, *bilaterally symmetrical*; hypanthium concave or narrow, sometimes flattish; *calyx lobes 5 or 3*, *minutely hairy on both surfaces*; *petals 0*; *stamens generally 2 or 6*, *anthers large*, *basifixed*, *sparsely hairy on both sides*; *ovary densely hairy*, *(1–)2-ovuled*. **Fruits** *drupaceous*, *not winged*, ellipsoid, ovoid, obovoid, subglobose, or globose, sometimes slightly compressed, *indehiscent*, often brown to black, shining; *exocarp thin crustaceous*, *usually hairy*. **Seeds** *usually 1 per fruit*, *smooth*, *surrounded by a sweet edible pulp*; endosperm present.

Distribution. A genus consisting of 27 species, distributed in tropical Africa, S America, Asia, and Malesia (not found in the eastern parts of Borneo and Java). Five species in Sabah and Sarawak.

Ecology. In well-drained primary and sometimes also in old secondary forests, scattered, at low and medium altitudes up to 1200 m.

Uses. The timber is very strong and hard, and suitable for making excellent tool handles, planes, furniture and for use in heavy construction. A little pulp surrounding the seed is edible, and the fruits are sold in village markets throughout Borneo. See Browne, FTSB (1955) 224–226; Burkill, EPMP (1966) 810–813; PROSEA 5, 1 (1993) 161–166.

Key to *Dialium* species

1. Leaves unifoliolate.......…………………………......…………….....…...**5. D. procerum**
   Leaves pinnate, each with 3 or more leaflets...........……....………………………………..2

2. Leaves each usually with 3–5 leaflets; often mixed with unifiolate leaves……….....……..
   …………………………………………………………………………....……….**3. D. kunstleri**
   Leaves each with 7–17 leaflets............……………………...…………………………...3

3. Leaves each usually with 15–17 leaflets. Ovary inserted on a flattish hypanthium…….. ……………………………………………………………...….**1. D. hydnocarpoides**
Leaves each often with 7–13 leaflets. Ovary inserted on a narrow or concave hypanthium.......…………………………………….......……………………………..…4

4. Hypanthium concave. Anthers V-channelled on the abaxial side; filaments flattish…… …………………………………………………………....……….**4. D. platysepalum**
Hypanthium narrow. Anthers not as above; filaments more or less subulate……..………… ……………………………………………………………………...….**2. D. indum**

1. **Dialium hydnocarpoides** de Wit

(Greek, *hudnon* = truffle, *karpos* = fruit, *-oides* = like; with truffle-like fruit)

Blumea 7 (1953) 320; Whitmore, Tantra & Sutisna *l.c.* 200; Rojo *l.c.* (1996) 609; Argent *et al.* (eds.) *l.c.* 355. **Type:** *NIFS 185T. 3P. 541*, Sumatra, Palembang (holotype L; isotype BO). **Synonym:** *D. praetermissum* de Wit *l.c.* (1953) 321.

Tree up to 30 m tall, 45 cm diameter; buttresses relatively high. **Leaves** up to 20(–24) cm long, *pinnate*, *each usually with 15–17 leaflets*. **Leaflets** subcoriaceous, *brownish hairy beneath*, *glabrescent*; elliptic-oblong, ovate, 3.5–6(–8.5) × 2–3(–3.5) cm, base usually rounded, *apex rounded*, *obtuse*, *or acute*; lateral veins 6–9 pairs, rather fine; intercostal venation reticulate, indistinct. **Inflorescences** terminal; rachis usually 9–15 cm long, densely brownish hairy; pedicel 1–2 mm long. **Flowers**: *calyx lobes 5*, ovate-lanceolate, 3.5–4 × 1.5–2.5 mm; *stamens 2*, *rarely 3*, filaments 1–1.5 mm long, anthers 2.5–3 mm long, *connective hairy on both sides*; *ovary inserted on a narrow*, patent-hairy, *flattish hypanthium*, 1.5–2 mm long. **Fruits** subglobose, sometimes slightly compressed, 1.5–2 cm diameter, *densely hairy*. **Seeds** orbicular, *c.* 0.9 × 0.8 cm, shining.

Distribution. Sumatra and Borneo. In Sabah, rare, known in Tawau district; not recorded in Sarawak. Also in Kalimantan.

Ecology. In primary forest at low altitude, rather rare and scattered. Flowering in January–July; fruiting in April–June.

2. **Dialium indum** L.

(Latin of the Indies)

Mant. 1 (1767) 24; Prain *l.c.* (1897) 169; Ridley *l.c.* (1922) 622; Backer & Bakhuizen *f. l.c.* 535; Whitmore *l.c.* 259; Cockburn *l.c.* 167; Anderson *l.c.* 234; Whitmore, Tantra & Sutisna *l.c.* 201; Turner *l.c.* 302; Rojo *l.c.* 609; Coode *et al.* (eds.) *l.c.* (1996) 162; Loo & Tan, *l.c.* 76; Argent *et al.* (eds.) *l.c.* 355. **Type:** *Linn. Herb. 23.1*, no exact locality (holotype LINN).

Tree up to 40 m tall, 100 cm diameter; buttresses up to 3 m high. **Leaves** *pinnate*, *each usually with 7–9 leaflets*; petiole and rachis usually 7–15 cm long. **Leaflets** subcoriaceous or stiff-coriaceous, glabrous above, *slightly hairy*, *glabrescent beneath*; ovate-oblong, ovate-lanceolate, broadly elliptic, sometimes broadly lanceolate, 6–10 × 3–5(–7) cm, base rounded or cuneate, *apex long-acuminate to cuspidate*, *obtuse or acute*; lateral veins 8–10(–14) pairs; intercostal venation fine, distinct beneath. **Inflorescences** terminal, rachis 10–20 cm long; pedicel 2–6 mm long. **Flowers:** *calyx lobes 5*, ovate-oblong or elliptic, *c*. 5 × 2.5 mm; *stamens 2*, *filaments more or less subulate*, *anthers oblong*, *c*. 4.5 mm long, *connective sparsely hairy on both sides*; ovary white hairy, *hypanthium narrow*. **Fruits** globose or ovoid, 1.5–2 × 1–1.5 cm, *hairy*. **Seeds** squarish or reniform, 0.7–1.2 × 0.5 cm.

Vernacular name. Sabah—*keranji* (preferred name).

Distribution. A species with 2 varieties distributed in Southernmost Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo, and Java. Both of the varieties are known for Sabah and Sarawak.

Key to varieties

Leaflets ovate-oblong or ovate-lanceolate; apex usually long-acuminate to cuspidate……....
var. **indum**

Turner *l.c.* 302; Rojo *l.c.* 611; Coode *et al.* (eds.) *l.c.* 162; Loo & Tan *l.c.* 77. Synonyms: *D. indum* L., Mant. 1 (1767) 24; *D. patens* Baker *in* Hooker *f.*, Fl. Brit. Ind. 2 (1878) 270, Ridley *l.c.* (1922) 622, Masamune *l.c.* 344, Whitmore *l.c.* 260; *D. marginatum* de Wit *l.c.* (1953) 320; *D. turbinatum* de Wit *l.c.* (1953) 320.

Southern Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo, and Java. Common in Sabah and Sarawak; also in Brunei. In lowland well-drained forests, sometimes in swampy areas, up to 1200 m altitude.

Leaflets broadly elliptic, sometimes broadly lanceolate; apex obtuse or abruptly acuminate…………………………....………....…………………………………………
var. **bursa** (de Wit) Rojo
(Latin, *bursa* = purse; inference unknown)

FM 1, 12 (1996) 612; Turner *l.c.* 302; Coode *et al.* (eds.) *l.c.* 162; Loo & Tan *l.c.* 77. Basionym: *Dialium laurinum* Baker var. *bursa* de Wit *l.c.* (1953) 320. Type: *NIFS. 186T. 1P. 197*, Sumatra, Palembang (holotype L; isotype K).

Sumatra, Peninsular Malaysia, Singapore, and Borneo. Known in Sabah, Sarawak and Brunei. In low, well-drained areas and hills, up to 1200 m altitude.

3. **Dialium kunstleri** Prain
(H.H. Kunstler, King's Collector in Perak *c*. 1880)

J. As. Soc. Beng. 65, 2 (1897) 168 & 484; Ridley *l.c.* (1922) 621; Whitmore *l.c.* 259; Whitmore, Tantra & Sutisna *l.c.* 201; Turner *l.c.* 302; Rojo *l.c.* 613; Coode *et al.* (eds.) *l.c.* 163; Argent *et al.* (eds.) *l.c.* 355. **Type:** *Kunstler 4415*, Peninsular Malaysia (holotype K; isotype BM).

Tree up to 40 m tall, 90 cm diameter. **Leaves** *pinnate*, *each with 3–5(–7) leaflets*, *often mixed with unifoliolate leaves*; petiole and rachis up to 5 cm long. **Leaflets** coriaceous, sparsely hairy, glabrescent beneath; usually elliptic, elliptic-oblong, or ovate to lanceolate, 5–15(–19) × 3–6(–7.5) cm, base cuneate or rounded, *apex long-acuminate or acute*; lateral veins often 6–8 pairs, rather distinct; petiolules 3–4(–7) mm long. **Inflorescences** usually axillary, rarely terminal, up to 12(–20) cm long; pedicel 3–4 mm long. **Flowers:** *calyx lobes 3*, elliptic-oblong, *c.* 3.5 × 2–2.5 mm, minutely hairy inside; *stamens 6*, anthers linear, 3–3.5 mm long, *sometimes hairy along both sides of the connective*; ovary *c.* 1.5 mm long, whitish hairy. **Fruits** ellipsoid or ovoid, 3–4 × 2.5–3 cm, *slightly hairy*, *becoming glabrous*. **Seeds** suborbicular, flattened, *c.* 1.5 cm across.

Distribution. A species with 2 varieties distributed in Peninsular Malaysia and Borneo. Both of the varieties occur in Sabah and Sarawak.

Key to varieties

Leaflets usually 5, sometimes mixed with 3 or 7...
var. **kunstleri**

Turner *l.c.* 302; Rojo *l.c.* 614; Coode *et al.* (eds.) *l.c.* 163. Synonyms: *D. silvestre* de Wit *l.c.* (1953) 321, Cockburn *l.c.* 167.

Peninsular Malaysia and Borneo. Common in Sabah and Sarawak; also in Brunei. In primary forests, up to 250 m altitude, occurring in *kerangas* forest in Sarawak.

Leaflets 3, often associated with unifoliolate leaves...
var. **trifoliolatum** (de Wit) Rojo
(Latin, with three leaflets)

l.c. 614; Turner *l.c.* 302. Basionym: *D. trifoliolatum* de Wit *l.c.* (1953) 321, Cockburn *l.c.* 167, Whitmore Tantra & Sutisna *l.c.* 201. Type: *NIFS bb 19826*, Kalimantan (holotype BO; isotypes L, SING).

Peninsular Malaysia and Borneo. In Sabah known from Keningau district; in Sarawak scattered. Also in Brunei and Kalimantan. In lowland forests below 450 m altitude.

4. **Dialium platysepalum** Baker

(Greek, *platus* = broad, *sepalum* = sepal; with broad sepals)

In Hooker *f.*, Fl. Brit. Ind. 2 (1878) 270; Prain *l.c.* (1897) 172; Ridley *l.c.* (1922) 623; Whitmore *l.c.* 261; Cockburn *l.c.* 165; Anderson *l.c.* 234; Whitmore, Tantra & Sutisna *l.c.* 201; Ng, MFFSS (1992) 428; Turner *l.c.* 302; Rojo *l.c.* (1996) 612; Coode *et al.* (eds.) *l.c.* 163; Loo & Tan *l.c.* 78; Argent *et al.* (eds.) *l.c.* 355. **Lectotype** (Rojo, 1996)**:** *Griffith 1847*, Peninsular Malaysia, Malacca (holotype K). **Synonyms:** *D. maingayi* Baker *in* Hooker *f. l.c.* 269; *D. ambiguum* Prain *l.c.* (1897) 172; *D. kingii* Prain *l.c.* (1897) 175; *D. havilandii* Ridl., Kew Bull. (1929) 259; *D. triste* de Wit *l.c.* (1953) 321.

Tree up to 45 m tall, 120 cm diameter. **Leaves** *pinnate*, *each usually with 7–13 leaflets*; petiole and rachis 15–24(–28) cm long. **Leaflets** opposite, (sub)coriaceous, *hairy beneath*; oblong-elliptic to oblong-lanceolate, 6–8(–15) × 2–4(–7) cm, base rounded or cuneate, *apex abrupt to long acuminate*; lateral veins usually 10–12 pairs, distinct beneath; petiolules 2–4.5 mm long. **Inflorescences** terminal; rachis 10–15(–30) cm long; pedicel 2.5–4 (–7) mm long. **Flowers:** calyx lobes 5, triangular, *c.* 6 × 4 mm; *stamens 2*, *filaments flattish*, *anthers c.* 4 mm long, *with both slits drawn towards the abaxial side*, *forming a V-channel on that side of hairy connective*; ovary 2–3.5 mm long; *hypanthium concave*. **Fruits** subglobose or obovoid, sometimes slightly compressed, usually 2–2.5 cm long, *densely brown velvety*. **Seeds** 1(or 2) per fruit, roundish or reniform, 0.3–1.3 × 0.9 cm.

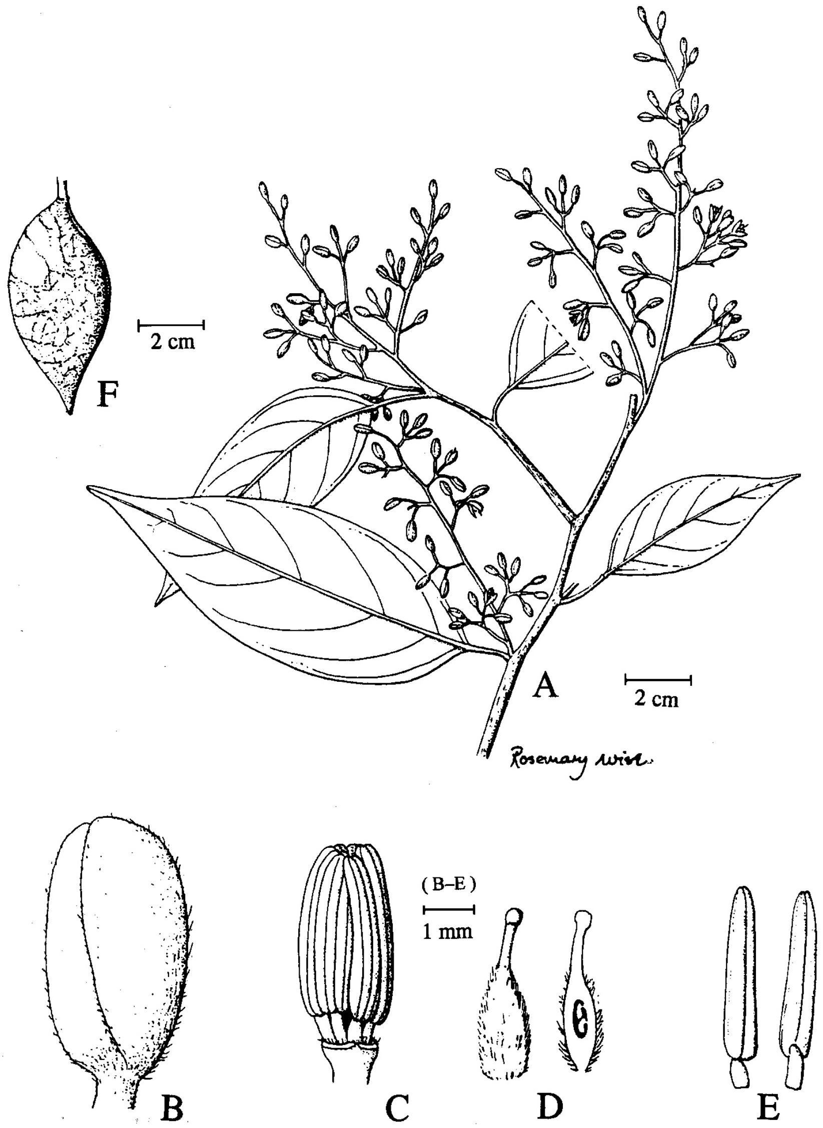

Fig. 6. *Dialium procerum*. A, flowering leafy twig; B, flower bud; C, flower bud with calyx lobes removed; D, pistil with one ovary in longitudinal section; E, stamens in different views; F, fruit. (After FM 1, 12 (1996) 615, f. 31.)

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah rare; in Sarawak throughout. Also in Brunei and Kalimantan.

Ecology. In lowland and freshwater swamp forests, up to 500 m altitude. Flowering throughout the year; fruiting heaviest in July–October.

5. **Dialium procerum** (Steenis) Steyaert Fig. 6.

(Latin, *procerum* = very tall, high; alluding a great respect to B.H. Danser by van Steenis, the founder of the genus *Dansera*)

Reinwardtia 2 (1953) 355; Whitmore *l.c.* 261; Anderson *l.c.* 234; Whitmore, Tantra & Sutisna *l.c.* 201; Turner *l.c.* 302; Rojo *l.c.* 614; Coode *et al.* (eds.) *l.c.* 163. **Basionym:** *Dansera procera* Steenis, Bull. Bot. Gard. Buitenz. 3, 17 (1948) 415. **Type:** *NIFS. 117T. 3P. 390*, Sumatra, Palembang (holotype L; isotype BO).

Tree up to 45 m tall, 90 cm diameter. **Leaves** *unifoliolate*; petiole and petiolule 1–3 cm long. **Leaflets** coriaceous, slightly hairy beneath, glabrescent; ovate or ovate-oblong, or elliptic, 6.5–16 × 3.5–7 cm, base rounded or cuneate, apex acuminate; lateral veins 6–8 pairs; intercostal venation reticulate, distinct. **Inflorescences** axillary or terminal, sometimes fasciculate; rachis 9–15 cm long; pedicel 2–4 mm long. **Flowers:** calyx lobes 3, elliptic, 3–4 mm long, minutely hairy inside; stamens 6, anthers linear, *c.* 2.5 mm long, glabrous or hairy on both sides of the connective; ovary 1.5–2 mm long. **Fruits** *c.* 4(–5) × 2.5 cm, slightly compressed, blackish, *hairs easily fallen*. **Seeds** reniform, *c.* 1.5 × 1 cm, brown, shining.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sarawak known from Kapit district; not yet found in Sabah. Also recorded for Brunei.

Ecology. In primary and old secondary forests, up to 600 m altitude. Flowering in June–March; fruiting in January–April.

7. **INTSIA** Thouars

(a Malagasy plant name)

merbau (Malay, preferred name)

Gen. Nov. Madag. (1806) 22; Backer & Bakhuizen *f.*, FJ 1 (1964) 529; Whitmore, TFM 1 (1972) 262; Cockburn, TS 1 (1976) 169; Anderson, CLTS (1980) 235; Cowan & Polhill *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 128; Corner, WSTM 3rd. edition 1 (1988) 438; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 202; Ding Hou, Blumea 38 (1994) 322, FM 1, 12 (1996) 622; Coode *et al.* (eds.), CLBD (1996) 163; Loo & Tan, Gard. Bull. Sing. 49, 1 (1997) 80; Argent *et al.* (eds.), MNDT-CK 2 (1997) 357.

Trees, often with buttresses. **Stipules** *intrapetiolar*, *minute*, connate, *caducous*. **Leaves** *compound*, *once pinnate and paripinnate*, *usually each with 2–4 pairs of leaflets*. **Leaflets** *usually with 1 or 2 small crateriform glands at the basal part on lower surface*; petiolules twisted. **Inflorescences** terminal or axillary, racemose, often fasciculate, or paniculate; bracts caducous. **Flowers** *bisexual*, *bilaterally symmetrical*; hypanthium cupular, narrowly infundibuliform or cylindrical; *calyx lobes 4*, *smooth outside*; *petals*: *only 1 fully developed*, *flabellate*; *stamens 3(–4) fertile*; *filaments and staminodes connate at the base*, anthers dorsifixed; ovary puberulous, style slender, stigma small, capitellate. **Fruits** *smooth*, oblong, rarely obcordate, straight, or falcate, flattened, glabrous, *dehiscent*, *often 3(–more)-seeded*; *valves coriaceous or slightly woody*, *straight or slightly twisting during dehiscence*. **Seeds** ovoid, oblong, discoid, or sublenticular, flattened, *not arillate*, *scurfy*.

Distribution. A genus comprising 2 species or more, distributed from Madagascar, islands of the Indian Ocean, tropical Asia, through Malesia to N Australia, Melanesia and Micronesia. Two species occur in Sabah and Sarawak.

Key to *Intsia* species

Leaves each with (1–)2(–3) pairs of leaflets. Hypanthium 6–10(–16) mm long. Fruits 8.5–15(–28) × 4–5(–7.5) cm...**1. I. bijuga**
Leaves each with (2–)4(–5) pairs of leaflets. Hypanthium 3–4 mm long. Fruits 15–19 (–40) × 6–7(–9) cm...**2. I. palembanica**

1. **Intsia bijuga** (Colebr.) Kuntze Fig. 7E.

(Latin, *bis* = twice, *-jugum* = paired; leaf with two pairs of leaflets)

Revis. Gen. Pl. 1 (1891) 192; Merrill *l.c.* (1921) 296; Masamune *l.c.* 346; Browne *l.c.* 229; Backer & Bakhuizen *f. l.c.* 529; Whitmore *l.c.* 262; Cockburn *l.c.* 170; Anderson *l.c.* 235; Corner *l.c.* 438; Keng *l.c.* (1990) 36; Whitmore, Tantra & Sutisna *l.c.* 202; Ding Hou *l.c.* (1994) 324; Turner *l.c.* 304; Ding Hou *l.c.* (1996) 623; Coode *et al.* (eds.) *l.c.* 163; Loo & Tan *l.c.* 81; Argent *et al.* (eds.) *l.c.* 357. **Basionym:** *Macrolobium bijugum* Colebr., Trans. Linn. Soc. 12 (1818) 359, *t.* 17. **Type:** *Based on Colebrooke's desc. & pl.* **Synonyms:** *Afzelia retusa* Kurz, J. As. Soc. Beng. 42, 2 (1873) 73, Ridley *l.c.* (1922) 639; *I. retusa* (Kurz) Kuntze, Revis. Gen. Pl. 1 (1891) 192, Meijer Drees, Bull. Jard. Bot. Buitenz. 3, 16 (1938) 88.

Tree up to 40 m tall, 100 cm diameter, but usually smaller; bole straight, sometimes crooked; buttresses when present up to 2(–4) m high and 200 cm wide. **Bark** dippled or later small-scaly. **Leaves** *each with (1–)2(–3) pairs of leaflets*; petiole and rachis (1.5–) 2.5–11.5 cm long, glabrous. **Leaflets** (broadly)elliptic, ovate, obovate, rarely suborbiculate, (2.5–)5–10(–18) × (1.5–)4–6(–12) cm, base acute, cuneate, or obtuse, often slightly asymmetrical, *apex obtuse*, *rounded*, *sometimes shortly acuminate*, *rarely slightly notched*; petiolules 2–6 mm long. **Inflorescences** up to 10(–17) cm long, pubescent, glabrescent, or more or less glabrous; pedicel 7–12 mm long. **Flowers:** *hypanthium 6–10(–16) mm long*; calyx lobes elliptic, 6–10(–16) × 4–5(–7.5) mm; petals: lamina 6–10(–30) × 10–15(–35) mm, claw *c.* 5 mm long; fertile stamens: filaments *c.* 30 mm long; ovary *c.* 7.5 mm long, *style c. 40 mm long*. **Fruits** brown or black when ripe, *8.5–15(–28) × 4–5(–7.5) cm*. **Seeds** 2–3.5 cm long and wide, *c.* 0.8 cm thick.

Vernacular names. Sabah—*epil*, *merbau paya* (Brunei Malay), *ipil* (Bajan), *ipil laut* (preferred name), *talolonandim* (Beaufort). Sarawak—*ipil* (preferred name).

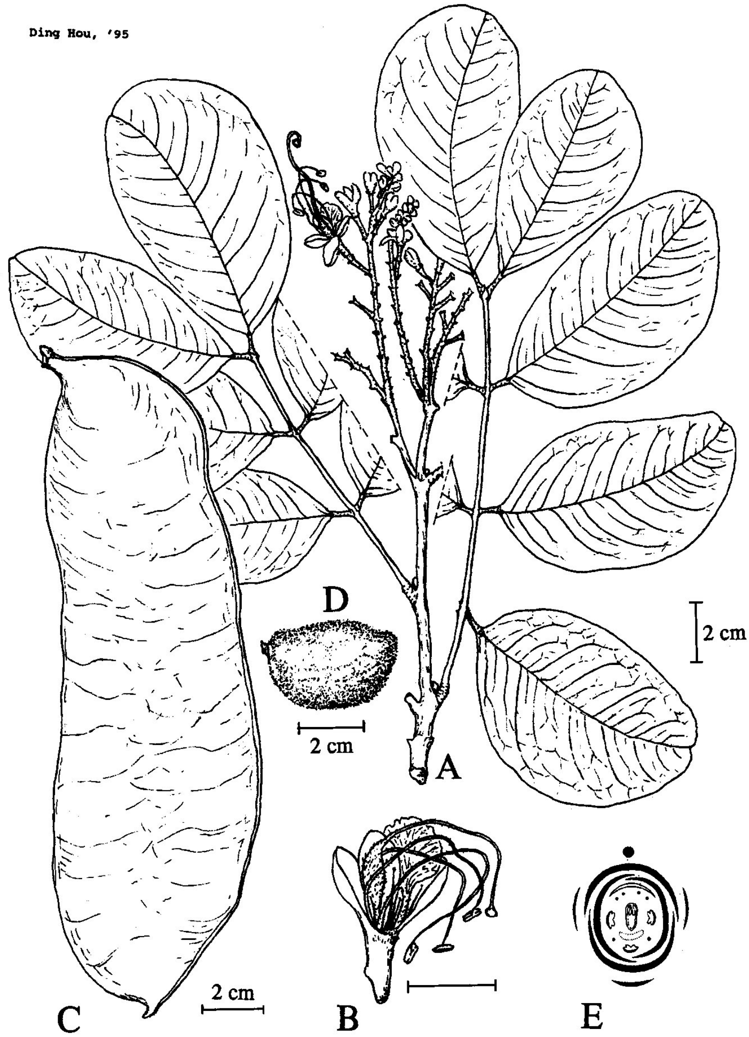

Fig. 7. *Intsia palembanica* (A–D); *I. bijuga* (E). A, flowering leafy twig; B, flower with one calyx lobe removed; C, fruit; D, seed; E, floral diagram. (After FM 1, 12 (1996) 621, f. 35.)

Distribution. As under the genus. Widespread in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. Along (sandy) sea coasts, edges of rivers, tidal or temporarily inundated places with brackish water, back mangroves, in primary and secondary inland forests, at altitudes from sea level up to 600 m. Flowering and fruiting all the year round.

2. **Intsia palembanica** Miq. Fig. 7A–D.

(of Palembang, Sumatra)

Fl. Ned. Ind., Suppl. (1861) 289; Browne *l.c.* 227; Whitmore *l.c.* 262; Cockburn *l.c.* 170; Anderson *l.c.* 235; Corner *l.c.* 438; Whitmore, Tantra & Sutisna *l.c.* 203; Ding Hou *l.c.* (1994) 324, *l.c.* (1996) 623; Turner *l.c.* 304; Coode *et al.* (eds.) *l.c.* 163; Argent *et al.* (eds.) *l.c.* 360. **Lectotype** (Ding Hou, 1994)**:** *Teijsmann 4535*, Sumatra, Lampong (holotype U). **Synonyms:** *Afzelia palembanica* (Miq.) Baker *in* Hooker *f.*, Fl. Brit. Ind. 2 (1878) 275; *I. plurijuga* Harms, Bot. Jahrb. 55 (1917) 54.

Tree up to 45 m (rarely more) tall, 100 cm (or more) diameter; buttresses up to 7 m high, extending outwards 600 cm, 30 cm thick. **Bark** grey to red-brown, often rather smooth, scaly in big trees; inner bark pale red, fibrous. **Sapwood** pale white to yellow, heartwood yellow-brown to dark brown. **Leaves** *each with (2–)4(–5) pairs of leaflets*; petiole and rachis (3.5–)9.5–17.5(–26) cm long, both puberulous, glabrescent. **Leaflets** ovate, elliptic, sometimes broadly ovate or broadly elliptic, or suborbicular, rarely obovate or lanceolate, (3–)10–13.5(–18.5) × (3–)5–7.5(–10.5) cm, base obtuse, rounded, cuneate, rarely slightly truncate or subcordate, often somewhat asymmetrical, *apex obtuse or rounded*, *sometimes slightly notched*, *(shortly)acuminate*; lateral veins 6–10 per side; petiolules 2–5 mm long. **Inflorescences** up to 10 cm long, pubescent, glabrescent; pedicel 3–12 mm long. **Flowers:** *hypanthium 3–4 mm long*; calyx lobes (broadly)elliptic, ovate, or slightly obovate, 6–8(–12) × 3–6.5(–8) mm; petals: lamina 3–6(–10) × 3–6.5(–8) mm, claw 2–5 mm long; fertile stamens: filaments 20–40 mm long; ovary 5–6 mm long, *style 20–35 mm long*. **Fruits** brown or black when ripe, smooth, *15–19(–40) × 5.5–7(–9) cm*. **Seeds** 3–4.5 × 1.5–3 cm, 0.5–1.2 cm thick.

Vernacular names. Sarawak—*ipil* (Murut), *lemelai* (Kayan, Kenyah), *merbau ayer*, *merbau bukit* (Iban).

Distribution. India (Andamans), Burma, Thailand, and Malesia: throughout (except Java?). Widespread in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In coastal regions, edges of seasonal swamps on inundated lands, in lowland primary or older secondary forests, sometimes on sandstone and limestone hills, at altitude from sea level up to 900 m. Flowering in January–April and August–November; fruiting in February–December.

Uses. Timber is rather heavy and is fairly durable. It is used for flooring and fine furnishings. (*cf.*: PROSEA 5, 1 (1993) 264–270; Vink *in* Ding Hou, Blumea 38 (1994) 322–323).

8. **KOOMPASSIA** Maingay *ex* Benth.

(from the Malay plant name *kempas*)

impas, *kempas* (Murut), *menggris* (Bidayuh), *tapang* (Malay, Sadong)

In Hooker, Icon. Pl. 12 (1873) 58, *t.* 1164; Prain, J. As. Soc. Beng. 66, 2 (1897) 165; Ridley, FMP 1 (1922) 620; de Wit, Bull. Bot. Gard. Buitenz. 3, 17 (1947) 309; Whitmore, TFM 1 (1972) 264; Cockburn, TS 1 (1976) 172; Anderson, CLTS (1980) 235; Irwin & Barneby *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 101; Corner, WSTM 3rd. edition 1 (1988) 438; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 203; Ding Hou, FM 1, 12 (1996) 631; Coode *et al*. (eds.), CLBD (1996) 163; Loo & Tan, Gard. Bull. Sing. 49, 1 (1997) 83; Argent *et al*. (eds.), MNDT-CK 2 (1997) 360. **Synonym:** *Abauria* Becc., Malesia 1 (1877) 169.

Trees. **Stipules** *free*, *very small and caducous*. **Leaves** *compound*, *once pinnate and imparipinnate*. **Leaflets** *5–12(–17) per leaf*, alternate, petiolulate; midrib furrowed above, prominent below; *lateral veins usually many*, *very slender*, *often obscure and hardly distinguishable especially on the upper surface*; intercostal venation loosely finely reticulate, often obscure or indistinct. **Inflorescences** axillary or terminal, paniculate; bracts and bracteoles minute, inconspicuous, usually caducous; pedicel very short or absent. **Flowers** *radially symmetrical*; *hypanthium 0*; *sepals 5*, puberulous to thinly pubescent; *petals 5*, *more or less equal in shape and size*; *stamens 5*, *free*, *more or less equal in length*, filaments very short, glabrous, *anthers basifixed*, *opening with apical and basal pores*, both pores connected by a thin (nearly) dehiscent rim and sometimes appearing as longitudinally dehiscent; *ovary* sessile or subsessile, *1-ovuled*, style and stigma rather short and small. **Fruits** *compressed*, *indehiscent* or slightly dehiscent only when germinating, *surrounded by a broad*, *papery wing*. **Seeds** strongly laterally compressed, without endosperm.

Distribution. A small genus of 3 species found in Sumatra, Peninsular Malaysia, Borneo, the Philippines, and New Guinea. Two species in Sabah and Sarawak.

Uses. Timber eminently suitable for heavy permanent structures, flooring material, and also good for railway sleepers, dock blocks, fence posts, shingles, etc. (*cf.*: Foxworthy, Mal. For. Rec. 3 (1927), 8; K. Heyne, Nutt. Pl. Ned.-Ind. 1, 1950, 739; Burkill, EPMP 2 (1966) 1285; Cockburn *l.c.* 174; PROSEA 5, 1 (1993) 270–275).

Key to *Koompassia* species

Leaflets obtuse or acute and slightly notched at the apex. Petals acute or acuminate at the apex. Fruits glabrous……………………………………………………**1. K. excelsa**
Leaflets acuminate at the apex. Petals rounded at the apex. Fruits pubescent………………
…………………………………………………………………………………**2. K. malaccensis**

1. **Koompassia excelsa** (Becc.) Taub. Fig. 8A–B.

(Latin, *excelsus* = lofty, high; the tree)

In Engler & Prantl, Nat. Pflanzenfam. 3, 3 (1891 156; Merrill, Philip. J. Sci. 10 (1915) Bot. 12, *l.c.*

(1921) 299; Ridley *l.c.* (1922) 620; Masamune *l.c.* 347; de Wit *l.c.* (1947) 311; Browne *l.c.* 230; Whitmore *l.c.* 264; Meijer *l.c.* 187; Cockburn *l.c.* 172; Anderson *l.c.* 235; K. Larsen & S.S. Larsen *l.c.* (1984) 84; Corner *l.c.* 439; Whitmore, Tantra & Sutisna *l.c.* 203; Ng *l.c.* 429; Turner *l.c.* 304; Ding Hou *l.c.* (1996) 632; Coode *et al.* (eds.) *l.c.* 163; Argent *et al.* (eds.) *l.c.* 360. **Basionym:** *Abauria excelsa* Becc., Malesia 1 (1877) 169. **Type:** *Beccari 1818*, Sarawak, Mt. Matang near Kuching (holotype FI). **Synonym:** *K. parvifolia* Prain *l.c.* (1897) 166 & 486, Ridley, Agric. Bull. Str. Fed. M.S. 1 (1902) 138 (as *parviflora*).

Giant tree up to 88 m tall, 100(–270) cm diameter; bole straight, smooth and cylindrical; buttresses steep, thick and up to 12 m high. **Bark** quite smooth, grey, often with a green tinge; inner bark red-brown, granular outwards, more fibrous inwards. **Stipules** oblong, 2–4.5 mm long, pubescent outside. **Leaves** *each with 7–12(–17) leaflets*; rachis slender, 6–7.5 cm long, pubescent, glabrescent; petiole *c.* 1.5 cm long. **Leaflets** glabrous except sparsely hairy above, *densely pubescent beneath*; elliptic-oblong, sometimes elliptic, symmetrical, 3.1–3.7(–4.2) × 1–1.4(–1.7) cm, base subrotundate to cuneate, *apex obtuse or acute and slightly notched*; petiolules short, 1–2.5 mm long, pubescent. **Inflorescences** to 11(–12.5) cm long; rachis pubescent; pedicel *c.* 1.5 mm long, densely puberulous. **Flowers:** sepals lanceolate, equally sized, 2.5–3.25 mm long, thinly puberulous outside; *petals* oblong or narrowly elliptic, 2.5–3 × 0.5 mm, *acute or acuminate at the apex*, glabrous; *stamens slightly longer than the petals*, *filaments stout*, *about as long as the anthers*, anthers oblong, 2–3 mm long, glabrous; ovary glabrous except with some hairs at the basal part, *style very short*, *c.* 0.3 mm long, stigma indistinct. **Fruits** *oblong or elliptic-obovate*, *8–12.5 × 2–3.5 cm* (including the wing), strongly veined, *glabrous*. **Seeds** very flat, compressed, oblong, 2–3 × 1 cm.

Vernacular names. Sabah—*mangaris* (preferred name). Sarawak—*tapang* (Malay, Sadong), *tahid* (Kayan, Kenyah, Punan Tutoh), *tanid* (Murut), *tanyit* (Berawan).

Distribution. S Thailand (Peninsula), Sumatra, Peninsular Malaysia, Singapore, the Philippines (Palawan), and Borneo. In Sabah common below 600 m altitude; in Sarawak throughout. Also in Brunei and Kalimantan.

Ecology. In primary forests, in stream valleys and lower slopes of ridges, up to 400(–600) m altitude. Flowering at irregular intervals, on average once in 5 to 6 (or even 25) years, in April–May, July–September, and December; fruiting rather rare, mainly in June–August, and October.

Uses. Timber used for indoor construction. The trees often remain in areas of secondary growth because they are rarely felled, and often deliberately left standing to provide nesting sites for wild honey-bees. (*cf.*: Burkill, EPMP, 2 (1966) 1305).

2. **Koompassia malaccensis** Maingay *ex* Benth. Fig. 8C.

(of Malacca, Peninsular Malaysia)

In Hooker, Icon Pl. 3, 12 (1876) 58, *t.* 1164; Prain *l.c.* (1897) 166; Merrill, Philip. J. Sci. 10 (1915) Bot. 12; Ridley *l.c.* (1922) 620; Steenis, Bull. Jard. Bot. Buitenz. 3, 12 (1932) 170; de Wit *l.c.* (1947) 317; Browne *l.c.* 232; Whitmore *l.c.* 265; Meijer *l.c.* 189; Cockburn *l.c.* 174; Anderson *l.c.* 235; K. Larsen & S.S. Larsen *l.c.* (1984) 84; Corner *l.c.* 397; Keng *l.c.* (1990) 36; Whitmore, Tantra & Sutisna *l.c.* 203; Ng

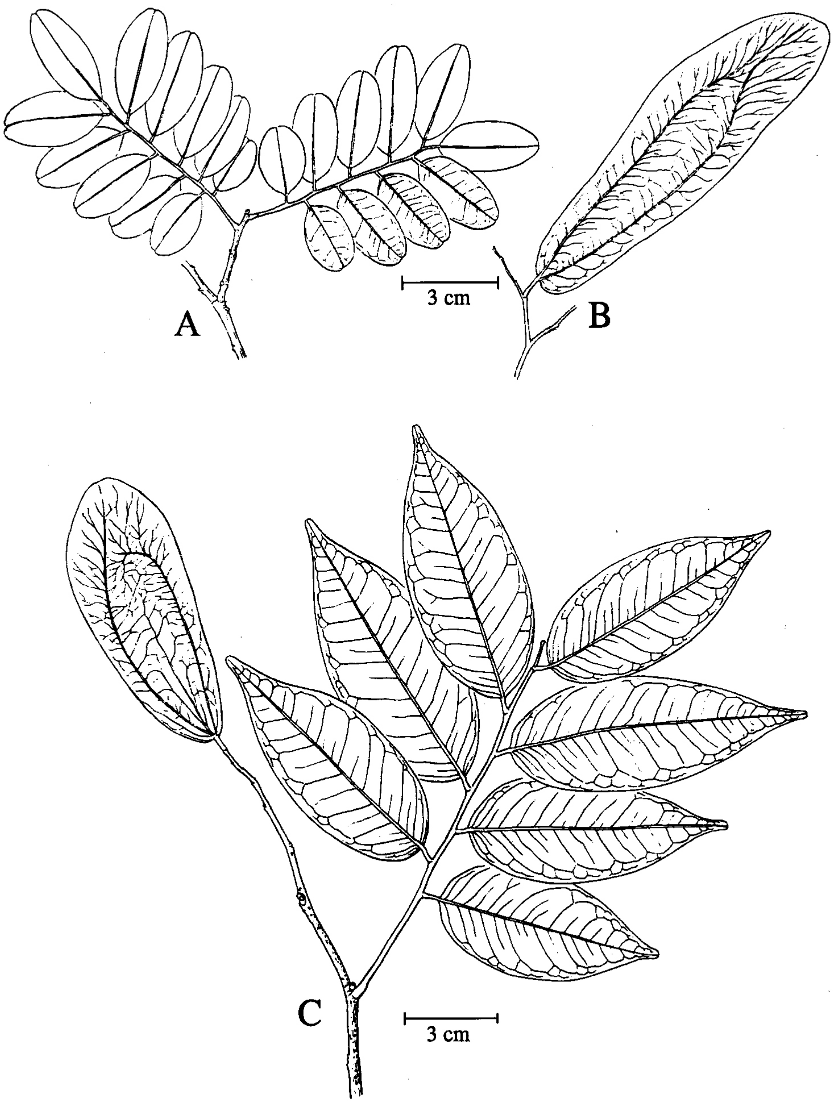

Fig. 8. *Koompassia excelsa* (A–B), *K. malaccensis* (C). A, leafy twig; B, winged fruits; C, leafy fruiting twig. (After Cockburn, TS (1976) 171, f. 37.)

l.c. 429; Turner *l.c.* 304; Ding Hou *l.c.* (1996) 634; Coode *et al.* (eds.) *l.c.* 163; Loo & Tan *l.c.* 84; Argent *et al.* (eds.) *l.c.* 363. **Lectotype** (de Wit, 1947)**:** *Maingay 604*, Peninsular Malaysia, Malacca (holotype K; isotype L). **Synonym:** *K. beccariana* Taub., Ber. Deutch. Bot. Ges. 10 (1892) 640, Merrill *l.c.* (1915) Bot. 12, *l.c.* (1921) 299, *l.c.* (1929) 105, Masamune *l.c.* 347.

Giant tree up to 60 m tall, 120 cm diameter; buttresses steep, plank-like, thick and up to 6 m high. **Bark** grey to brown, minutely fissured and flaking. **Stipules** broadly ovate, *c.* 2 mm long, pubescent outside. **Leaves** *each with 5–9(–14) leaflets*; rachis slender, 6.5–19 cm long, pubescent, glabrescent; petiole 1.5–4 cm long. **Leaflets** glabrous except minutely puberulous on the midrib above, *densely to thinly pubescent beneath*; ovate-elliptic, elliptic-oblong or lanceolate, more or less symmetrical, 5.5–10.4(–12.5) × 1.5–5 cm, base usually rounded, *apex acuminate*; petiolules short, 4–7.5(–9) mm long, densely minutely puberulous. **Inflorescences** up to 12 cm long; rachis pubescent, densely flowered; pedicel 0.75–2.5 mm long, densely puberulous. **Flowers:** *sepals* lanceolate, 2.5–3 × 1 mm, *densely puberulous outside*; *petals* orbicular to obovate, *c.* 2.5 × 1.1 mm, *rounded at the apex*, *glabrous*; stamens nearly half the length of the petals, filaments slender, 0.5–0.75 mm long, anthers heart-shaped, about as long as the filaments, glabrous; ovary *c.* 1 mm long, densely dark brown puberulous, style very short and stigma indistinct. **Fruits** *oblong*, *9.5–15 × 3–4.5 cm* (including the wing), *pubescent*, veined. **Seeds** very flat, compressed, irregularly oblong, up to 3.3 × 1 cm, purplish-black and shallowly rugose.

Vernacular names. Sabah—*impas* (preferred name), *kempas* (Malay). Sarawak—*apas* (Melanau), *impas* (Murut), *kempas* (Murut), *kumpas* (Bidayuh, Sadong), *menggris* (Bidayuh, preferred name).

Distribution. Sumatra, Peninsular Malaysia (throughout), Singapore, and Borneo. In Sabah less common than *K. excelsa*; in Sarawak throughout. Also in Brunei and Kalimantan.

Ecology. In lowland and hill forests, up to 800 m, often favouring an altitude not exceeding 150 m, also found in peat and freshwater swamp forests. Flowering and fruiting all the year round.

9. **LEUCOSTEGANE** Prain

(Greek, *leukos* = white, *steganos* = covered; the flower covered with white calyx)

Ann. Bot. Gard. Calc. 9, 1 (1901) 37; Ridley, FMP 1 (1922) 643; Whitmore, TFM 1 (1972) 266; Anderson, CLTS (1980) 236; Cowan & Polhill *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 128; Ding Hou, FM 1, 12 (1996) 635.

Trees. **Stipules** *intrapetiolar*, *foliaceous*, *persistent*. **Leaves** *compound*, *once pinnate and paripinnate*, *each with (1–)2–5(–6) pairs of leaflets*. **Leaflets** petiolulate, stipellate. **Inflorescences** *on trunks or older branches*, *or in the axils of fallen leaves*, *racemose*, *fascicled*; bracts and bracteoles small, persistent beyond anthesis or deciduous; pedicel articulated above the 2 bracteoles. **Flowers** *bisexual*, *bilaterally symmetrical*; *hypanthium infundibuliform*, *tubular*, *or cylindrical*; *calyx lobes 4*; *petals 2(or 1) developed*, lateral; *stamens 2 fertile*; *ovary 2–5(or more)-ovuled*. **Fruits** recurved, oblong, compressed, *smooth*,

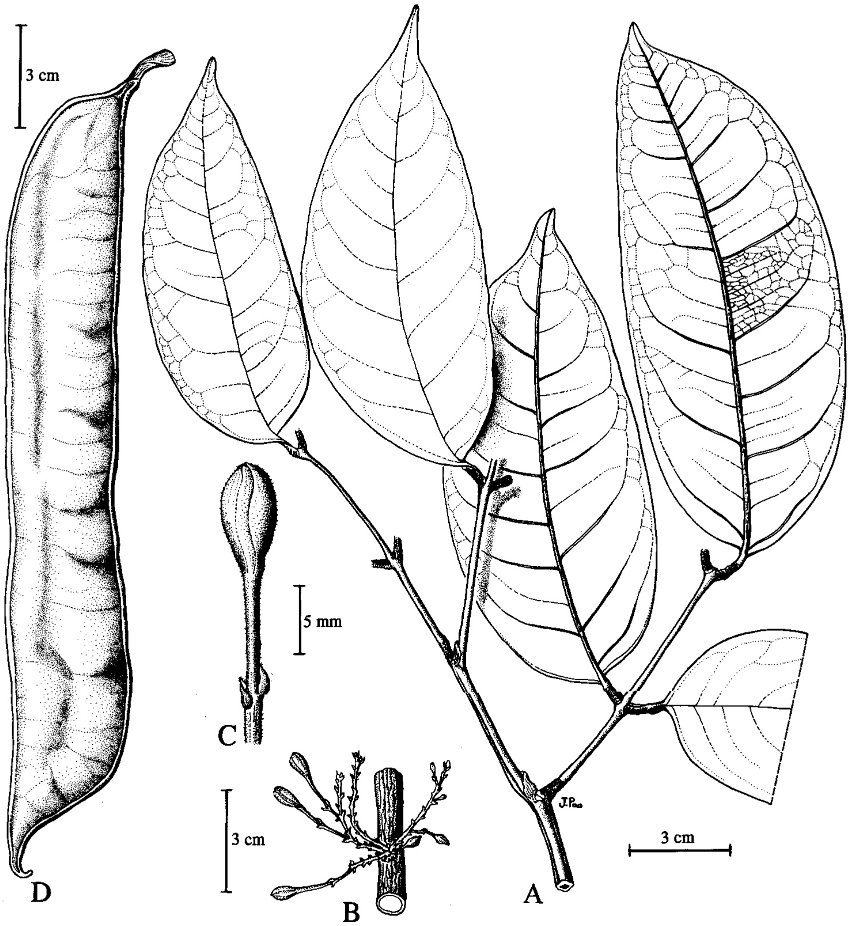

Fig. 9. *Leucostegane grandis*. A, leafy twig; B, portion of older twig with inflorescences; C, flower buds; D, fruit. (From *Haviland 1799.*)

shortly beaked, *dehiscent*, *3–5-seeded*; *valves coriaceous or woody*, *at length twisted*. **Seeds** discoid or ellipsoid.

Distribution. In Malesia 2 species. Only 1 species in Sarawak, not yet recorded in Sabah.

Ecology. In lowland forest.

Leucostegane grandis Ridl. Fig. 9.

(Latin, *grandis* = great; inference unclear)

Kew Bull. (1929) 257; Anderson *l.c.* 236; Ding Hou *l.c.* (1996) 636. **Type:** *Haviland 1799*, Borneo, Sarawak, Kuching (holotype K; isotype L).

Tree up to 12 m tall, 16 cm diameter. **Stipules** ovate, up to 5 mm long. **Leaves** *each with (1–)2(–3) pairs of leaflets*, glabrous; petiole and rachis 3.5–8.5 cm long. **Leaflets** elliptic, oblong, 8.5–18(–27.5) × 2.5–8.5(–9.5) cm, base obtuse, sometimes slightly unequal, *apex acuminate*; lateral veins 7–12 per side, inconspicuous, sometimes visible beneath; intercostal venation often obscure or invisible; petiolules *c.* 6 mm long; stipels very small. **Inflorescences** 3.5–5(–8) cm long; pedicel up to 20 mm long. **Flowers:** *calyx lobes* obovate or oblanceolate, 10–12 × 4–5 mm, *almost glabrous* except sometimes ciliate on the margins; petals small, ovate or elliptic, 7–9 × 2–4.5 mm, shortly clawed at base; stamen *filaments c.* 12 mm long, *dilated at base*; ovary pubescent. **Fruits** hatchet-shaped, *c.* 26 × 5 cm. **Seeds** (young) elliptic, *c.* 1.5 × 0.8 cm.

Distribution. Sumatra and Borneo. In Borneo, only known from Kuching and Nanga Pelagos, in Sarawak.

Ecology. In lowland forest, also found in swampy places. Flowering in January, April, July, and September; fruiting in April.

10. **PELTOPHORUM** (Vogel) Benth., *nom. cons.*

(Greek, *pelte* = shield, *pherein* = to bear; bearing a shield-shaped stigma)

In Hooker, J. Bot. 2 (1840) 75; Prain J. As. Soc. Beng. 66, 2 (1897) 223; Ridley, FMP 1 (1922) 646; Backer & Bakhuizen *f.*, FJ 1 (1964) 547; Whitmore, TFM 1 (1972) 267; Cockburn, TS 1 (1976) 175; Anderson, CLTS (1980) 237; Polhill & J.E. Vidal *in* Polhill & Raven (eds.), Adv. Leg. Syst. (1981) 90; Corner, WSTM 3rd. edition 1 (1988) 440; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 204; Ding Hou, FM 1, 12 (1996) 650; Coode *et al.* (eds.), CLBD (1996) 163; Loo & Tan, Gard. Bull. Sing. 49, 1 (1997) 86. **Basionym:** *Caesalpinia* sect. *Peltophorum* Vogel, Linnaea 11 (1837) 406. **Synonym:** *Baryxylum* Lour., Pl. Cochinch. (1790) 266, *nom. rejic.*

Trees, *unarmed*. **Stipules** *lobed or branched*, often persistent, or small and caducous. **Leaves** *compound*, *bipinnate*, deciduous. **Leaflets** small, *numerous (4–27 pairs per pinna)*. **Inflorescences** terminal and/or axillary, racemose or paniculate; bracts present, sometimes caducous; bracteoles lacking. **Flowers** *bisexual*; *hypanthium very short or obscure*; *calyx lobes 5*; *petals* 5, *12–25 mm long*; *stamens 10*, *free*, *filaments thickened and pilose at* *the basal part*; *ovary 3–8-ovuled*, style filiform, incurved, stigma prominent, peltate or capitate. **Fruits** oblong, hard, compressed, *indehiscent*, *1–6-seeded*; *with a firm*, *wing-like extension on each suture*, *usually longitudinally striate*. **Seeds** lenticular, compressed, without endosperm.

Distribution. A pantropical genus of about 15 species with 3 of them occurring in Sabah and Sarawak.

Key to *Peltophorum* species

1. Inflorescences or infructescences terminal and axillary, paniculate. Pedicel 5–7 mm long...**2. P. pterocarpum**
   Inflorescences or infructescences axillary, racemose. Pedicel 10–40 mm long..............2

2. Leaves with 3–5 pairs of pinnae; stipules lanceolate to linear, caducous. Pedicel 10–12 mm long. Seeds longitudinally positioned in the pod.........................**3. P. racemosum**
   Leaves with 5–9 pairs of pinnae; stipules lobed and usually relobed, often persistent. Pedicel 20–40 mm long. Seeds more or less transversely positioned in the pod.............. ....**1. P. dasyrhachis**

1. **Peltophorum dasyrhachis** (Miq.) Kurz Fig. 10A–C

(Greek, *dasus* = densely hairy, *rachis* = axis; axis of a compound leaf or an inflorescence densely hairy)

J. As. Soc. Beng. 45, 2 (1876) 128, *l.c.* (1877) 293; Prain *l.c.* (1897) 224; Ridley *l.c.* (1922) 647; Backer & Bakhuizen *f. l.c.* 547; Whitmore *l.c.* 267; K. Larsen & S.S. Larsen *l.c.* (1980) 60, *l.c.* (1984) 54; Corner *l.c.* 440; Ng *l.c.* 430; Turner *l.c.* 307; Ding Hou *l.c.* (1996) 650. **Basionym:** *Caesalpinia dasyrhachis* Miq., Fl. Ned. Ind., Suppl. (1861) 292. **Type:** *Teijsmann s.n.*, Sumatra, Lampong (holotype L; isotype K).

Tree up to 30 m tall; young branchlets brownish red tomentose, glabrescent. **Stipules** *lobed and usually relobed, often persistent*. **Leaves:** petiole up to 5.5(–7) cm and rachis up to 32 cm long, both tomentose; *pinnae 5–9 pairs*. **Leaflets** *6–16 pairs per pinna*, sessile, *finely pubescent on both surfaces*, glabrescent, sometimes almost glabrous above; oblong or elliptic-oblong, 1–2.5 × 0.4–1 cm, base acute, obtuse or rounded, *apex obtuse or slightly emarginate*. **Inflorescences** *axillary*, *racemose*, 15–30 cm long; rachis pubescent; bracts linear, 10–12 mm long, more or less persistent; *pedicel 20–40 mm long*. **Flowers:** *calyx lobes* 10–15 × 5–6 mm, *tomentose outside*; *petals* obovate, 15–25 × 10–12 mm, *hairy towards the base of the inner side*; stamens with filaments 10–15 mm long; *ovary velutinous*, *4–8-ovuled*, style *c.* 12 mm long. **Fruits** reddish brown, elliptic, 10–15 × 2–4 cm (including wing-like extension of 4–5 mm wide), *tapering towards both ends*, *brown-pubescent*, glabrescent, not or indistinctly striate. **Seeds** 4–8, flat, 0.1–1.2 × 0.5 cm, *more or less transversely positioned in the pod.*

Distribution. Thailand, Cambodia, Laos, Vietnam, Sumatra, Peninsular Malaysia, and Borneo. In Sabah known from Sandakan and Keningau districts; in Sarawak recorded for Kuching district. Also in Kalimantan.

Ecology. In lowland forest. Flowering in February–July and November–December; fruiting in January, March, May–June, and December.

2. **Peltophorum pterocarpum** (DC.) Backer *ex* K. Heyne

(Greek, *pteron* = wing, *karpos* = fruit; the winged fruit)

Nutt. Pl. Ned.-Ind., ed. 2, 2 (1927) 755; Backer & Bakhuizen *f. l.c.* 547; Burkill *l.c.* 1715; Whitmore *l.c.* 268; Hattink, Reinwardtia 9 (1974) 59; Cockburn *l.c.* 175; Verdcourt *l.c.* 16; Anderson *l.c.* 237; K. Larsen & S.S. Larsen *l.c.* (1980) 62, *l.c.* (1984) 54; Corner *l.c.* 440; Keng *l.c.* (1990) 37; Whitmore, Tantra & Sutisna *l.c.* 205; Rudd *l.c.* 57; Ng *l.c.* 430; Turner *l.c.* 308; Ding Hou *l.c.* (1996) 651; Coode *et al.* (eds.) *l.c.* 163; Loo & Tan *l.c.* 86. **Basionym:** *Inga pterocarpa* DC., Prodr. 2 (1825) 441. **Type:** *S. coll., s.n.*. "*in ins. Timor. Fl. ign.* (v.s. comm. à Mus. Par.)" (holotype P; isotype K). **Synonyms:** *Caesalpinia inermis* Roxb., Fl. Ind. ed. Carey 2 (1832) 367; *P. inerme* (Roxb.) Llanos *in* Blanco, Fl. Filip. Ed. 3 (1877–83) *t.* 335, Merrill *l.c.* (1921) 301, Masamune *l.c.* 350.

Tree up to 35 m tall, 100 cm diameter. Young shoots pubescent or tomentose, glabrescent. **Stipules** *small*, *linear*, *not lobed*, *caducous*. **Leaves:** petiole up to 10 cm and rachis up to 26 cm long; *pinnae 4–14 pairs*. **Leaflets** *(8–)10–15(–22) pairs per pinna*, sessile, nearly glabrous above, *finely pubescent*, glabrescent *beneath*; oblong, 1–2 × 0.3–1 cm, base unequally acute or attenuate, or rounded, *apex obtuse*, *rounded or slightly emarginate*. **Inflorescences** *terminal and axillary*, *paniculate*, up to 40 cm long, densely pubescent; bracts minute, deltoid, 5–8 mm long, caducous; *pedicel usually 5–7 mm long*. **Flowers:** *calyx lobes* slightly triangular, 5–8 × 5–6 mm, *pubescent outside*; *petals* obovate, 17–25 × 10–13 mm, *densely hairy towards the basal part*; stamen filaments 12–15 mm long; *ovary hairy*, *3–4-ovuled*. **Fruits** oblong-elliptic, up to 14 × 2.5 cm (including wing-like extension of 4–5 mm wide), pubescent, glabrescent or almost glabrous, *1–4-seeded*. **Seeds** oblong, flat, 1–1.2 × 0.5 cm, light brown, *longitudinally positioned in the pod*.

Vernacular name. Sabah and Sarawak—*kupang* (Malay).

Distribution. Sri Lanka, Thailand, Cambodia, Vietnam, throughout Malesia to northern Australia. In Sabah recorded from Kota Kinabalu (Pulau Gaya), Kudat, Sandakan, and Tawau districts; in Sarawak uncommon but widespread. Also in Brunei.

Ecology. Frequently growing along beaches and behind the mangroves, often in lowland, open forests, occasionally found on limestone plateau. Flowering and fruiting all the year round.

Uses. Widely introduced and cultivated in the tropics. Planted as shade trees in plantations and as an very attractive ornamental in parks and along roadsides. Bark is used for dyes and for various traditional medicinal purposes. (*cf.*: K. Heyne, Nutt. Pl. Ned.-Ind. 1 (1950) 755; Burkill, EPMP 2 (1966) 1715).

3. **Peltophorum racemosum** Merr. Fig. 10D–E.

(Latin, *racemus* = raceme; the inflorescence)

Philip. J. Sci. 11 (1916) Bot. 84, *l.c.* (1921) 301; Masamune *l.c.* 350; Meijer *l.c.* 191; Cockburn *l.c.* 175;

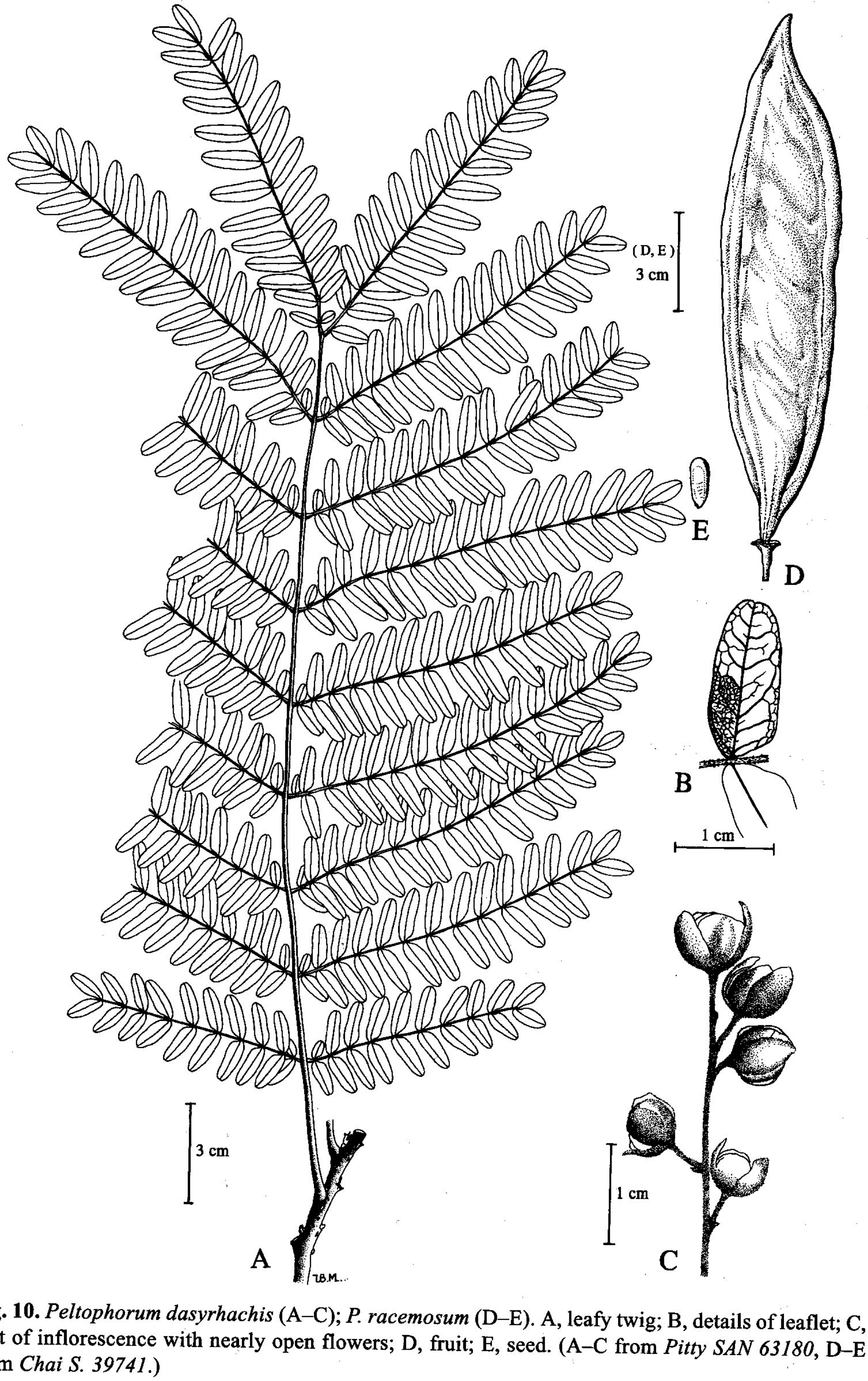

Fig. 10. *Peltophorum dasyrhachis* (A–C); *P. racemosum* (D–E). A, leafy twig; B, details of leaflet; C, part of inflorescence with nearly open flowers; D, fruit; E, seed. (A–C from *Pitty SAN 63180*, D–E from *Chai S. 39741*.)

Whitmore, Tantra & Sutisna *l.c.* 205; Ding Hou *l.c.* (1996) 653. **Type:** *Hubert Winkler 2424*, Borneo, Kalimantan (isotype L).

Tree up to 60 m tall, 80 cm diameter; buttresses flat, *c.* 1 m high, 100 cm extending outward, 4 cm thick. Young shoots prominently ferruginous-pubescent. **Stipules** *lanceolate to linear*, *c.* 5 mm long, *caducous*. **Leaves:** petiole up to 10 cm and rachis up to 20 cm long; *pinnae 3–5 pairs*, up to 10 cm long. **Leaflets** *4–11 pairs per pinna*, sessile or subsessile, upper surface glabrous except sometimes slightly hairy on the midrib, *lower surface covered with short*, *appressed hairs*; oblong, oblong-elliptic, 20–30(–60) × 8–12(–25) mm, base subacute or obtuse, *apex broadly rounded and minutely apiculate*; lateral veins up to 14 per side, visible or distinct on both surfaces. **Inflorescences** *axillary*, solitary, *racemose*, up to 27 cm long; rachis pubescent; bracts triangular, *c.* 3 mm long, caducous; *pedicel 10–12 mm long*. **Flowers**: *hypanthium shortly discoid*, *c.* 5 mm diameter; *calyx densely pubescent outside*, lobes oblong, 7–10 × 4–5 mm, pubescent at the lower half inside; petals suborbicular, subreniform, or broadly obovate, 12–16 mm long and wide, pubescent at the lower half outside and at the basal part inside; stamen filaments 7–10 mm long; *ovary* elliptic or lanceolate, 4–6 mm long, densely pubescent, *4-ovuled*. **Fruits** elliptic, narrow-elliptic, or obovate-elliptic, flat, 12–15.5(–19) × 3–4 cm (including marginal extension of *c.* 5 mm wide), loosely pubescent, glabrescent, or almost glabrous. **Seeds** elliptic, flat, *c.* 2 × 1 cm, *longitudinally positioned in the pod*.

Vernacular name. Sabah—*timbarayong* (preferred name).

Distribution. Endemic to Borneo. In Sabah and Sarawak scattered and widespread. Also in Kalimantan.

Ecology. In lowland primary forest. Flowering in April and June; fruiting in February–October.

11. **SARACA** L.

(possibly relates to the Javanese plant name *soka*,
derived from the Indian Sanskrit name *asoka*)

babai (Iban), *biyau* (Bidayuh), *gaparang* (Murut), *gapis* (Malay), *kelangan* (Kenyah)

Mant. Pl. 1 (1767) 98; Prain, J. As. Soc. Beng. 66, 2 (1897) 210; Ridley, FMP 1 (1922) 640; Backer & Bakhuizen *f.*, FJ 1 (1964) 527; Zuijderhoudt, Blumea 15 (1968) 414; Whitmore, TFM 1 (1972) 268; Cockburn, TS 1 (1976) 175; Anderson, CLTS (1980) 238; Cowan & Polhill *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 128; Corner, WSTM 3rd. edition 1 (1988) 441; Ding Hou, FM 1, 12 (1996) 660; Coode *et al.* (eds.), CLBD (1996) 163; Argent *et al.* (eds.), MNDT-CK 2 (1997) 366. **Synonym:** *Jonesia* Roxb., Asiat. Res. 4 (1799) 355, *cum pl.*, Wight, Icon. Pl. Ind. Orient. 1 (1839) *t.* 206.

Shrubs or trees. **Stipules** axillary, enveloping the bud, *minute and usually caducous*. **Leaves** spiral, *compound*, *once pinnate and paripinnate*, *each with 1–7 pairs of leaflets*, subsessile to shortly petioled. **Leaflets** *sometimes with a pair of wart-like glands at the base and/or at the apex*; lateral veins more or less straight or slightly curved and obliquely upward towards the margins, usually elevated and distinct beneath; petiolules very short. **Inflorescences** terminal or axillary, or on older branches, often rather dense, corymbose or paniculate, usually many-flowered; bracts caducous or persistent; *bracteoles* (sub)opposite, *often coloured and showy*; pedicel very short. **Flowers** *bisexual*, *or functionally male* (with a short, small, sterile or rudimentary pistil); *hypanthium cylindrical or tubular*; *calyx lobes 4(–6)*, *subequal*, *petaloid*; *petals 0*; *stamens usually 4 fertile*, in one whorl, filaments exserted, *anthers often shortly hairy at apex and/or base*; *ovary* oblong or lanceolate, *usually 2–8-ovuled*; style filiform, stigma terminal, minute, obtuse. **Fruits** *smooth outside*, suborbicular, broadly ovoid, ellipsoid, or obovoid, flattened, straight or distinctly curved, coriaceous or woody, *dehiscent*, *1–8-seeded*; *valves twisting and enrolling during dehiscence*. **Seeds** ovoid, ellipsoid, or subglobose, smooth, compressed or subterete, *without aril*.

Distribution. A genus of about 11 closely allied species distributed in India, Sri Lanka, SE Asia, and Malesia. Two species in Sabah and Sarawak.

Ecology. In lowland forests especially growing along streams.

Uses. Trees of some species are cultivated in gardens for ornamental purpose. The trees are rather small, so the wood is used for making small utensils.

Key to *Saraca* species

Hypanthium 7–15(–32) mm long, 0.5–2 times longer than the calyx lobes. Ovary with more ovules (often 6–8). Fruits oblong or lanceolate, usually 7–31 × 3–7 cm, 6–8-seeded…….. ……………………………………………………..…………**1. S. declinata**

Hypanthium (3–)5.5–7 mm long, about the same length as the calyx lobes. Ovary with only 2 ovules. Fruits suborbicular, broadly ovoid or obovoid, or oblong, 4–8 × 3–4 cm, 1–2-seeded…………………………………………………….....……………**2. S. hullettii**

1. **Saraca declinata** (Jack) Miq. Fig. 11A–E.

(Latin, *declinatus* = bent or curved downwards, or drooping; the branches)

Fl. Ned. Ind. 1, 1 (1855) 84 & 1080; Prain *l.c.* (1897) 211; Ridley *l.c.* (1922) 641; Merrill, J. Arn. Arbor. 33 (1952) 228; Zuijderhoudt *l.c.* 419; Whitmore *l.c.* 269; Cockburn *l.c.* 178; Verdcourt *l.c.* 89; Anderson *l.c.* 238; J.E. Vidal, Fl. Cambodia, Laos & Vietnam 18 (1980) 133; Fl. Thail. 4 (1984) 95; Corner *l.c.* 444; Turner *l.c.* 309; Ding Hou *l.c.* (1996) 665; Coode *et al.* (eds.) *l.c.* 163.; Argent *et al.* (eds.) *l.c.* 369. **Basionym:** *Jonesia declinata* Jack, Mal. Misc. 2(7) (1822) 74; reimpr. in Hooker, Comp. Bot. Mag. 1 (1836) 223. **Type:** *Jack s.n.*, Sumatra (isotype G?). **Synonyms:** *S. macroptera* Miq., Fl. Ned. Ind. 1, 1 (1855) 1080, Merrill *l.c.* (1921) 296, Ridley *l.c.* (1922) 642; *J. palembanica* Miq., Fl. Ned. Ind., Suppl. (1861) 291; *S. palembanica* (Miq.) Baker *in* Hooker *f.*, Fl. Brit. Ind. 2 (1878) 272, Ridley *l.c.* (1922) 642; *S. triandra auct. non* (Roxb.) Baker, Ridley *l.c.* (1922) 642; *S. lanceolata* Merr. *l.c.* (1929) 100; *S. crassifolia* Ridl., Kew Bull. (1933) 491; *S. elmeri* Ridl., Kew Bull. (1938) 492; *S. elegans* Ridl. *l.c.* (1938) 278; *S. longistyla* Ridl. *l.c.* (1938) 279.

Tree up to 30 m tall, 60 cm diameter, sometimes treelet up to 6 m tall; buttresses very small. **Bark** smooth, grey, greenish black, lenticellate, longitudinally fissured, flaking in

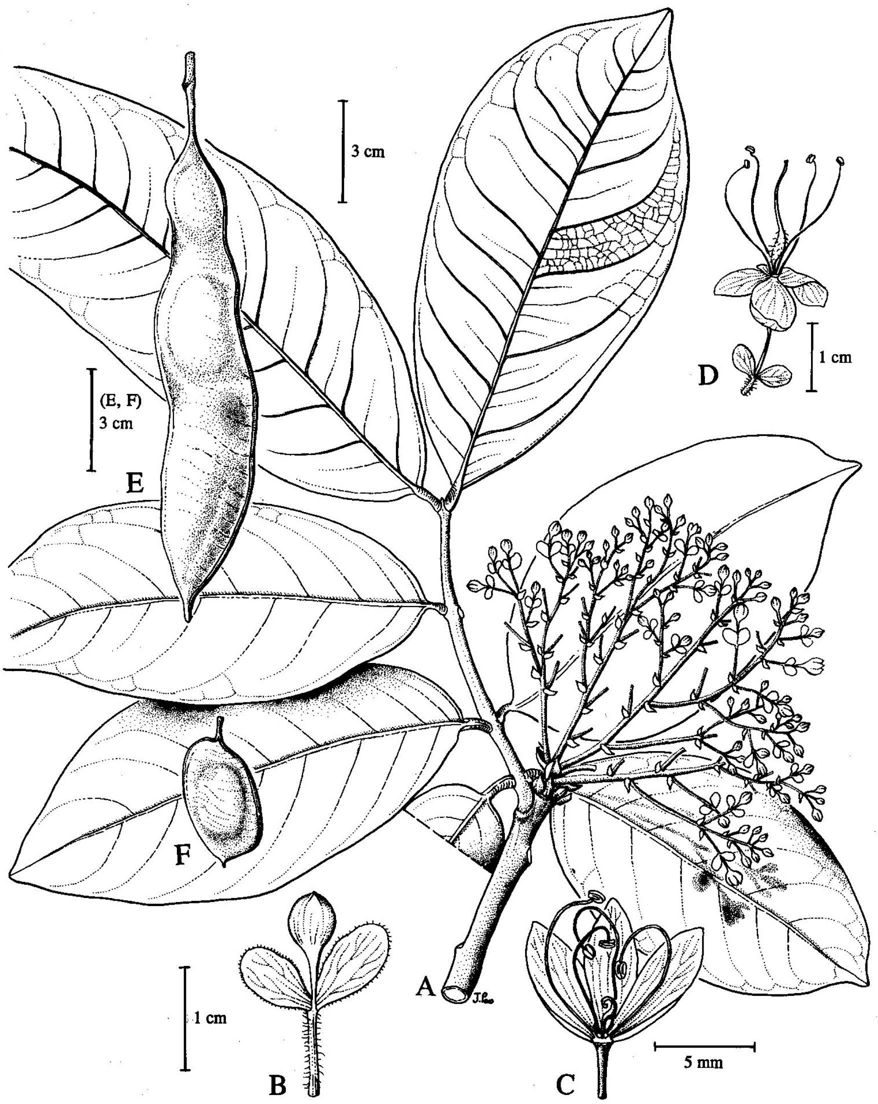

Fig. 11. *Saraca declinata* (A–E), *S. hullettii* (F). A, flowering leafy twig; B, flower bud with a pair of well-developed bracteoles; C, almost open flower with one calyx lobe removed; D, fully open flower; E and F, fruits. (A–C from *Brand SAN 24451*, D from *Sigin et al. SAN 56754*, E from *Buntar SAN 27259*, F from *Jamaat FD. FMS 39673*.)

small pieces; inner bark brown, reddish brown, firmly fibrous. **Sapwood** white, soft. **Leaves** *each with (1–)3–5(–7) pairs of leaflets*; petiole and rachis (4.5–)8.5–56 cm long. **Leaflets** glabrous; elliptic-lanceolate, lanceolate, or oblanceolate, 4–30(–50) × 1.5–11(–20) cm, base cuneate, obtuse, or rounded, rarely subcordate for the lowest pair, symmetrical, *apex acuminate*, *acute*, *or obtuse*; lateral veins 6–12 per side; petiolules often very short, sometimes up to 10 mm long. **Inflorescences** slightly pubescent or subglabrous, main branches (1–)7–10(–30) cm long; pedicel 10–15(–35) mm long. **Flowers** puberulous outside; *hypanthium 7–15(– 32) mm long*; calyx lobes ovate, elliptic, or obovate, 6–15 × 3–7 mm; *stamens (3–)4(–5)*, *filaments 16–38 mm long*, *glabrous*; *ovary* puberulous, *6–8(–10)-ovuled*, *style 7–20 mm long*. **Fruits** *oblong or lanceolate*, *7–31 × 3–7 × 1.2 cm*, woody, *6–8-seeded*; *valves coiling during dehiscence*. **Seeds** ovoid-oblong, *c.* 4 × 2 cm.

Vernacular names. Sabah—*bakis*, *bokis*, *balanut*, *dulanut*, *jambakia* (Dusun); *gapis* (preferred name), *kachang kachang*, *langsat monyet* (Malay), *marang parang*, *pasoi*, *selungapid*, *tagandop*, *tambakis* (Dusun); *tululs hobui* (Kadazan). Sarawak—*babai* (Iban).

Distribution. India, Burma, Indo-China, Thailand, and Malesia. Widespread in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary mixed dipterocarp forest, along rivers and streams, often drooping over the water, sometimes in swamp forest or secondary vegetation, on hill slopes, basalt hillside, clay or clay loam soils, rich soils, and occasionally on slopes of limestone hills, up to 800 m altitude. Flowering and fruiting all the year round.

2. **Saraca hullettii** Prain Fig. 11F.

(R. Hullett, 1843–1914, England, a schoolmaster in Singapore, a member of the Gardens Committee)

J. As. Soc. Beng. 65, 2 (1897) 492; Merrill *l.c.* (1921) 296; Ridley *l.c.* (1938) 278; Masamune *l.c.* 352; Zuijderhoudt *l.c.* 418; Anderson *l.c.* 238; Ding Hou *l.c.* (1996) 667. **Syntypes:** *Hullett 312* and *Haviland s.n.* (CAL), and *Beccari PB 916* (K), all from Sarawak.

Tree up to 20 m tall, 30 cm diameter. **Bark** smooth, greyish, light or pink-brown. **Sapwood** white. **Leaves** *each with 2 or 3 pairs of leaflets*; petiole and rachis 3–16 cm long. **Leaflets** glabrous; lanceolate, 5.5–35 × 2–11 cm, base cuneate to attenuate, sometimes obtuse, symmetrical, *apex acuminate rarely caudate*; lateral veins 9–11 per side; petiolules 2–10 mm long. **Inflorescences** puberulent, main branches 7–14 cm long; pedicel 22–30 mm long. **Flowers** glabrous outside; *hypanthium (3–)5.5–7 mm long*, hairy at the upper half inside; calyx lobes ovate, elliptic, oblong, or obovate, (3–)5–10 × (2–)4–5.5 mm; *stamens 4*, *rarely 3*, filaments 15–25 mm long, *glabrous*; *ovary 2-ovuled*, *style 8–12 mm long*. **Fruits** *suborbicular*, *broadly ovoid or obovoid*, *or oblong*, *4–8 × 3–4 cm*, thinly woody, *1–2-seeded*. **Seeds** (young) ovoid, *c.* 1.5 × 1 cm.

Vernacular name. Sarawak—*bi-n* (Iban).

Distribution. Endemic to Borneo. In Sabah recorded for Tawau district; in Sarawak known from Bintulu, Kuching, Marudi, Miri, and Serian districts. Also in Brunei and Kalimantan.

Ecology. In lowland and riverine forests, often immediately beyond tidal limits, on clayey soils, sandstone or limestone, once found in peatswamp forest, up to 300 m altitude. Flowering in January, March–April, and July–November; fruiting in July and October.

12. **SINDORA** Miq.

(Latinised local tree name *sindur*)

borak (Bidayuh, Padawan), *petir* (Iban), *sepetir* (Malay)

Fl. Ned. Ind. 1 (1860) 287; de Wit, Bull. Bot. Gard. Buitenz. 3, 18 (1949) 5; Backer & Bakhuizen *f.*, FJ 1 (1964) 526; Whitmore, TFM 1 (1972) 270; Cockburn, TS 1 (1976) 178; Anderson, CLTS (1980) 238; Cowan & Polhill *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 132; Corner, WSTM 3rd. edition 1 (1988) 445; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 207; Ding Hou, FM 1, 12 (1996) 691; Coode *et al.* (eds.), CLBD (1996) 164; Loo & Tan, Gard. Bull. Sing. 49, 1 (1997) 98; Argent *et al.* (eds.), MNDT-CK 2 (1997) 369. **Synonym:** *Echinocalyx* Benth. *in* Bentham & Hooker *f.*, Gen. Pl. 1 (1865) 584 & (1867) 1003.

Trees. **Stipules** foliaceous, free, rarely connate at the lower half. **Leaves** *compound*, *once pinnate and paripinnate*, *each with 2–10 pairs of leaflets*, petioled. **Leaflets:** midrib slightly grooved above, prominent below; lateral veins many, usually more than 20 per side, obscure or faint above, visible or distinct beneath, obliquely ascending towards and close to the margins and forming a thickened vein; intercostal venation fine, very closely reticulate on both surfaces; petiolules short. **Inflorescences** *solitary or fascicled*, *paniculate or racemose*; bracts and bracteoles small, often caducous or sometimes present at anthesis. **Flowers** *bisexual*, *bilaterally symmetrical*, shortly pedicelled or subsessile; *hypanthium very short*; *calyx lobes* 4, narrowly imbricate, *outer surface often with spiny outgrowths*; *petals 1*, usually fleshy, rudimentary ones often wanting; *stamens 10 (9 + 1)*, uppermost one free and reduced to a short staminode, remaining 9 shortly and obliquely united at base and sheath-like, the united part often hairy on both surfaces, 2 upper ones fertile with elongate filaments and ovoid or oblong, longitudinally dehiscing, dorsifixed anthers, 7 lower ones with shorter filaments and with or without small, imperfect anthers; *ovary 2–5(or more)-ovuled*, style filiform, often recurved, stigma small. **Fruits** flat, rounded ovate or elliptic, *often spiny*, *rarely unarmed*, *dehiscent*, *woody*, *2-valved*. **Seeds** few, black, shining, *with a large fleshy aril at the base.*

Distribution. A genus comprising 18–20 species, distributed in W Africa (Gabon, 1 sp.), SE Asia, Peninsular Malaysia, Singapore, Indonesia, Borneo, and the Philippines. Eight species in Sabah and Sarawak.

Ecology. In lowland forests, favouring well-drained areas, sometimes occurring near the banks of brooks or small rivers, often scattered, growing singly or in small groups, up to 150 m, sometimes to 350 m, very rarely at higher altitudes.

Uses. Plants of some species produce strong and durable timber of excellent quality, resin or wood-oil, medicine, tannin, etc. (*cf.*: K. Heyne, Nutt. Pl. Ned.-Ind. 1 (1950) 727–730; Burkill, EPMP 2 (1966) 2067–2070; PROSEA 5, 1 (1993) 434–442).

Key to *Sindora* species

(for flowering material)

1. Leaflets usually glabrous on both surfaces, except sometimes sparsely hairy on the midrib beneath…..……………………………..................….…...………………………………2
   Leaflets usually only minutely puberulous, pubescent, or hirsute on the lower surface, rarely sparsely puberulous above..........…………..………..……………...……………..4

2. Apex of leaflets usually obtuse, acute, sometimes slightly emarginate. Calyx lobes 4.5–5(–6) mm long.........………………………………………………..…………...**6. S. leiocarpa**
   Apex of leaflets usually shortly acuminate to acuminate. Calyx lobes 6.5–10 mm long.........……………………………………….......………………..……………………..3

3. Apex of leaflets with a gland at the tip on the lower surface. Calyx lobes without spiny outgrowths on the outer surface...............………………………………..……..**3. S. coriacea**
   Apex of leaflets without a gland as above. Calyx lobes with spiny outgrowths on the outer surface..........…………………………………......………………**1. S. affinis**

4. Leaves usually with 3 or 4 pairs of leaflets..........……………..…...…..………………...5
   Leaves usually with 5 or 6 pairs of leaflets............………………………..…..……………7

5. Calyx lobes without spiny outgrowths on the outer surface....……...…......**2. S. beccariana**
   Calyx lobes bearing spiny outgrowths on the outer surface...............…………………….....6

6. Apex of leaflets obtuse. Calyx lobes broadly ovate or lanceolate, 4–5.5 × 1.5–2.5 mm……………………………………………………...……………...**4. S. echinocalyx**
   Apex of leaflets usually acute or subacuminate. Calyx lobes lanceolate, up to 9.5 × 3 mm......…………………………………………...…………………**8. S. wallichii**

7. Under surface of leaflet usually densely hirsute, sometimes slightly glabrescent…..…….. …………………………………………………………...……………...**7. S. velutina**
   Under surface of leaflet sparsely and minutely puberulous, glabrescent, sometimes almost glabrous except on the midrib……………………............…………....**5. S. irpicina**

Key to *Sindora* species

(for fruiting material)

1. Fruits armed or bearing spines…..........……………………..…………………………...2
   Fruits unarmed or smooth without spines..............………………………………………7

2. Leaflets usually glabrous on both surfaces..…......…………………………**1. S. affinis**
   Leaflets puberulous, pubescent, or hirsute on the lower surface...........………………..3

3. Leaves usually with 3 or 4 pairs of leaflets.........…………………..…………………….4
   Leaves usually with 5 or 6 pairs of leaflets........…………………….…………………6

4. Leaflets obtuse, slightly notched at the apex.......……………………..…**4. S. echinocalyx**
   Leaflets usually acute, subacuminate to attenuate.........…………………………………5

5. Fruits broadly ellipsoid or suborbicular, 7–8 cm wide, covered with scattered spine…..
………………………………………………………………………..……..**2. S. beccariana**
Fruits suborbicular, broadly obovoid or ellipsoid, 4–6 cm wide, covered with dense spines………..………………………………………………..……………...**8. S. wallichii**

.

6. Leaflets densely hirsute on the lower surface. Fruits covered with small, scattered spines and with fine warts among them......……………......…………………..**7. S. velutina**
Leaflets often minutely puberulous on the lower surface. Fruits covered with slender, numerous spines and without fine warts among them…......…..…………**5. S. irpicina**

7. Leaflets shortly to distinctly acuminate, apex with a gland at the tip on the lower surface.......………………………………………………………...………..**3. S. coriacea**
Leaflets usually obtuse, acute, or shortly acuminate, sometimes slightly emarginate, apex without a gland as above…………………………….........……....**6. S. leiocarpa**

1. **Sindora affinis** de Wit

(Latin, *affinis* = allied to; inference unknown)

Bull. Bot. Gard. Buitenz. 3, 18 (1949) 16; Whitmore, Tantra & Sutisna *l.c.* 207; Ding Hou *l.c.* (1996) 694. **Type:** *bb 19774*, Kalimantan, Tidung lands near Nunukan (holotype BO; isotype L).

Tree up to 35 m tall, 60 cm diameter. **Bark** rather smooth, hardly cracked, light brown; inner bark pale brown to purplish black. **Sapwood** white, heartwood light brown, streaked with darker bands. **Leaves** *each with (3–)4–5(–6) pairs of leaflets*; petiole 1.5–3(–5) cm and rachis 4–14 cm long, slightly puberulous, glabrescent, or almost glabrous. **Leaflets** *often almost glabrous on both surfaces*, *except sparsely hairy on the midrib of lower surface*; oblong or oblong-elliptic, elliptic, or ovate 2.5–8(–9.5) × 2–4(–5) cm, base rotundate, often symmetrical, *apex shortly acuminate or acuminate*, *without a gland at the tip on the lower surface*. **Inflorescences** paniculate, 9–20 cm long; both rachis and branches densely tawny puberulous; bracts and bracteoles lanceolate, 3–4 mm long, densely puberulous; pedicel 1–3(–5) mm long, densely puberulous. **Flowers:** *calyx lobes with spiny outgrowths on the outer surface*, elliptic or lanceolate, *7–10 × 3–5 mm*, densely puberulous outside and appressed hairy inside; *petals* elliptic, 8 × 2–3 mm, *outside densely puberulous and inside glabrous*; stamens: free filaments and staminodes to *c.* 12 mm long, sparsely hairy often at the lower part or at base, or glabrous; *ovary c.* 2 mm long, *densely woolly*, *5–6-ovuled*, style up to 15 mm long. **Fruits** (young) ellipsoid, slightly asymmetrical, 5–8.5 × 3–4.5 cm, flattened, slightly minutely hairy, *not veined*, *with scattered*, *very short spines*; *beak very short*. **Seeds** only very young ones seen.

Vernacular name. Sabah—*sepitir* (Tawau).

Distribution. Endemic to Borneo. In Sabah found in Tawau district; not reported for Sarawak. Also in Kalimantan.

Ecology. In lowland forest, growing in well-drained areas in sandy or clayey soils, once found in loam soils on sandstone, up to 60 m altitude. Flowering in April and July; fruiting in May.

2. **Sindora beccariana** Backer *ex* de Wit

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Bull. Bot. Gard. Buitenz. 3, 18 (1949) 18; Cockburn *l.c.* 181; Anderson *l.c.* 239; Whitmore, Tantra & Sutisna *l.c.* 207; Ding Hou *l.c.* (1996) 694; Coode *et al.* (eds.) *l.c.* 164; Argent *et al.* (eds.) *l.c.* 370. **Type:** *Beccari 529*, Borneo (no precise locality) (holotype BO; *cf.* de Wit, 1949, f. 2g, based on the type).

Tree up to 40 m tall, 80 cm diameter. **Bark** smooth, greenish or dark grey, brown-mottled; inner bark whitish or reddish. **Sapwood** whitish to brownish, heartwood streaky. **Leaves** *each with 3–4 pairs of leaflets*; petiole 2.5–3.5 cm and rachis 8–14 cm long, slightly puberulous, glabrescent, or almost glabrous. **Leaflets** upper surface often almost glabrous, *lower surface densely minutely rusty puberulous*; elliptic, ovate-elliptic, or ovate, 3.5–8.5 × 1.7–4 cm, base rotundate, obtuse, or slightly cuneate, often symmetrical, *apex acuminate to attenuate*. **Inflorescences** paniculate, up to 16 cm long; both rachis and branches densely puberulous; bracts and bracteoles ovate to lanceolate, 1–2.5 mm long; pedicel 1–1.5 mm long. **Flowers:** *calyx lobes* narrowly imbricate, lanceolate or elliptic, 5.5–7 × 2–2.5 mm, *unarmed*, *densely puberulous on both surfaces*; *petals* elliptic or slightly obovate-oblong, 5 × 2.5–3.5 mm, *outside densely puberulous in the lower half*, *inside glabrous except with appressed hairs on the vertical*, *central part*; stamens: *free filaments and staminodes* up to 10 mm long, *hairy often on the lower half*; *ovary densely woolly*, *2–3-ovuled*, style up to 12 mm long. **Fruits** purple, *broadly ellipsoid or suborbicular*, *7–9(–11) × 7–8 cm*, flattened, hard, *evenly covered with scattered, sharp spines* (*c.* 5 mm long). **Seeds** broadly ovate or suborbicular, *c.* 3.5 × 3 cm.

Vernacular names. Sabah—*sampa rantu*, *sinampar*, *sindur* (Malay), *sepetir* (preferred name).

Distribution. Endemic to Borneo. In Sabah known from Beaufort, Labuk Sugut, Lahad Datu, Sandakan, Sipitang, Tenom, and Tawau districts; in Sarawak recorded for the 1st and 4th Divisions, more common near the coast. Also in Brunei and Kalimantan.

Ecology. In lowland forests in flat or sloping country, sometimes near the banks of brooks, scattered, rare or sometimes locally common, growing on well-drained often sandy loam or clay soils, often below 100 m, once recorded from *c.* 850 m altitude (Sabah: Weston, Beaufort district). Flowering in June–July and November; fruiting in April–June and September–December.

Use. The timber is cut and exported as a fine wood for joinery (Cockburn, 1976).

3. **Sindora coriacea** (Baker) Prain

(Latin, *coriaceus* = leathery; the leaves)

J. As. Soc. Beng. 66, 2 (1897) 206 & 482; Ridley *l.c.* (1922) 639; Merrill *l.c.* (1929) 99; Masamune *l.*c. 353; de Wit *l.c.* (1949) 30; Whitmore *l.c.* 271; Cockburn *l.c.* 182; Anderson *l.c.* 239; K. Larsen & S.S. Larsen *l.c.* (1984) 98; Whitmore, Tantra & Sutisna *l.c.* 207; Turner *l.c.* 310; Ding Hou *l.c.* (1996) 697; Loo & Tan *l.c.* 99. **Basionym:** *Afzelia ?coriacea* Baker *in* Hooker *f.*, Fl. Brit. Ind. 2 (1878) 275. **Type:** *Maingay 566*, Peninsular Malaysia, Malacca (holotype K).

Tree up to 33 m tall, 95 cm diameter; buttresses up to 0.6 m high and spread. **Bark** dark brown, smooth, surface faintly hooped or cracked; inner bark fawn or brown, granular. **Sapwood** white or pale yellow. **Stipules** caducous. **Leaves** *each with 3 or 4 pairs of leaflets*; petiole (1.5–)2.5–4 cm and rachis 5.5–10(–14) cm long, glabrous. **Leaflets** *often almost glabrous on both surfaces*; elliptic, ovate, or slightly obovate, (3.5–)5–10(–15) × (2–)3–5(–7.5) cm, base acute, cuneate, obtuse, or rounded, sometimes unequally sided, *apex shortly acuminate or acuminate*, *rarely rounded or retuse*, *with a gland at the tip on the undersurface*. **Inflorescences** paniculate, up to 20(–30) cm long; both rachis and branches densely puberulous; bracts and bracteoles ovate or lanceolate, 1.5–3 mm long, densely puberulous; pedicel 1–2.5 mm long, densely puberulous. **Flowers:** *calyx lobes* elliptic or lanceolate, *6.5–7.5 × 2.5–3 mm*, *outside densely puberulous and without spiny outgrowths*, *densely appressed hairy insides*; *petals* slightly obovate-oblong, 6.5–7.5 × 3–3.5 mm, *outside densely puberulous*, *inside glabrous* except the villose margin; stamens: *free filaments and staminodes* up to 12 mm long, *sparsely hairy often at the lower part or at base*, *or glabrous*; *ovary c.* 4 mm long, *densely woolly along the suture*, *4–5-ovuled*, style up to 10 mm long. **Fruits** (young) ellipsoid or slightly broadly ellipsoid, 7–10 × 4–6 cm, *flattened*, *often unequally sided*, *slightly minutely hairy*, faintly veined, *unarmed*. **Seeds** 2 or 3, *arillate*.

Vernacular names. Sabah—*sepetir* or *sapetir* (Malay, commonly used).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah scattered, widespread; not reported in Sarawak. Also in Brunei and Kalimantan.

Ecology. In forests at low altitudes, favouring well-drained sandy or leached soils. Flowering in March–September; fruiting throughout the year.

4. **Sindora echinocalyx** (Benth.) Prain

(Greek, *echinus* = hedge-hog, sea-urchin, *calyx* = calyx; calyx with some spiny outgrowths)

J. As. Soc. Beng. 66, 2 (1897) 204 & 481 (*quoad Griffith K distr. no. 1848*, *excl. syn.*); Symington, Kew Bull. (1938) 75 & 77; de Wit *l.c.* (1949) 34; Whitmore *l.c.* 272; K. Larsen & S.S. Larsen *l.c.* (1984) 99; Turner *l.c.* 310; Ding Hou *l.c.* (1996) 698. **Basionym:** *Echinocalyx* Benth. *in* Bentham & Hooker *f.*, Gen. Pl. 1 (1865) 584 & 1003, *pro gen.* **Lectotype** (Symington, 1938)**:** *Griffith Kew Distr. no. 1848*, Peninsular Malaysia, Malacca (holotype K; isotype L). **Synonym:** *S. wallichii auct. non* Benth. *in* Benth. & Hook. (*quoad Griffith K distr. 1848*): Benth. *in* Hooker, Ic. Pl. (1867) *t.* 1017, Ridley *l.c.* (1922) 637, *p.p.*

Tree up to 40 m tall, 70 cm diameter; buttresses absent. **Bark** smooth, brown with grey patches, rough. **Stipules** *foliaceous*, up to 8 mm long, early caducous. **Leaves** *each with 3 or 4 pairs of leaflets*; petiole 2–2.5 cm and rachis *c.* 7 cm long, minutely puberulous, glabrescent. **Leaflets** upper surface glabrous, *lower surface puberulous especially on the midrib*; elliptic or elliptic-oblong, rarely obovate, 4–7.5 × 2–3 cm, lower ones usually smaller than the upper ones, base obtuse or rotund, often symmetrical, *apex obtuse*, *the very tip slightly notched*. **Inflorescences** paniculate, up to 15 cm long; both rachis and branches densely puberulous; bracts and bracteoles triangular, ovate or lanceolate, 4–7 mm long; pedicel very short. **Flowers:** *calyx lobes broadly ovate or lanceolate*, *4–5.5 × 1.5–2.5 mm*, *puberulous and bearing some spiny outgrowths outside*, *puberulous insides*;

petals slightly obovate or elliptic, *c.* 5 × 2.5 mm, *puberulous outside and glabrous inside*; stamens: *free filaments* up to 10 mm long, *slightly hairy at the lower part*; *ovary c.* 5 mm long, *densely hairy*, *with numerous minute*, *spiny outgrowths*, *2–4-ovuled*, style up to 10 mm long. **Fruits** ovoid or broadly ellipsoid, or suborbiculate, 4–6.5 × 3.5–6 cm, *flattened*, *covered with close, hard, straight spines* (up to 4 mm long), *1–2(–3)-seeded*. **Seeds** *arillate*.

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo known from Sandakan district, in Sabah.

Ecology. In forests on hillsides and ridges, from lowland up to 600 m altitude.

5. **Sindora irpicina** de Wit

(Latin, *irpicinus* = like a rake or harrow; the pod bearing evenly distributed and equally sized prickles)

Bull. Bot. Gard. Buitenz. 3, 18 (1949) 50; Cockburn *l.c.* 182; Whitmore, Tantra & Sutisna *l.c.* 207; Ding Hou *l.c.* (1996) 700; Argent *et al.* (eds.) *l.c.* 374. **Type:** *Nieuwenhuis & Jaheri 908* (24-4-1896), cult. in Hort. Bog. sub no. I-E-4a, coll. 13-5-1941, Borneo, Kalimantan (holotype BO).

Tree up to 40 m tall, 80 cm diameter; buttresses very short. **Bark** smooth, light brown, thin, with transverse elevated ridges and scattered large, protruding lenticels; inner bark light brown, very hard. **Sapwood** pale or whitish brown, heartwood chocolate with darker concentric rings. **Leaves** *each with (3–)5 pairs of leaflets*; petiole 2.3–3.8 cm and rachis 7.5–19.5 cm long, slightly puberulous, glabrescent, or almost glabrous. **Leaflets** upper surface glossy and glabrous, *lower surface glossy*, *sparsely and minutely puberulous*, *glabrescent*, *sometimes almost glabrous except on the midrib*; elliptic, oblong-elliptic or rarely obovate, 5.4–10.5 × 2.1–4.8 cm, base obtuse, rounded, acute or slightly cuneate, often symmetrical, *apex acuminate to attenuate*. **Inflorescences** paniculate, up to 16 cm long; both rachis and branches pubescent; pedicel 3–5 mm long. **Flowers:** *calyx lobes* lanceolate, 3.5–6 × c. 3 mm, *unarmed*, *puberulous outside*, *densely appressed hairy insides*; *petals* ovate, *c.* 5 × 3 mm, *deeply concave to involute*, *outside densely puberulous in the lateral parts*, *inside glabrous*; stamens: *free filaments and staminodes* up to 10 mm long, *sparsely hairy in the lower half*, anthers 2 (perfect) largest, ellipsoid, *c.* 0.35 mm long; *ovary c.* 4 mm long, *densely woolly*, *with many minute outgrowths*, *3–5-ovuled*, style up to 14 mm long. **Fruits** black, ellipsoid or oblong-ellipsoid, rarely slightly reniform, 11–14 × 5.5–8 cm, flattened, hard, *covered with evenly spaced, numerous, slender, sharp spines* (*c.* 3 mm long), *without fine warts among them*, *1–3-seeded*. **Seeds** broadly suborbicular, *c.* 1.8 cm long and wide, smooth; *aril reniform*, *c.* 3 × 1.5 cm.

Vernacular name. Sabah—*sepetir* (preferred name).

Distribution. Endemic to Borneo. In Sabah widespread, common; in Sarawak recorded for Kapit district. Also in Brunei and Kalimantan.

Ecology. In lowland forests, often near the banks of brooks, on sandstone, sandy limestone, shales, sandy and volcanic soils, up to 700 m altitude. Flowering in May; fruiting in March–April, June–July, September, and November.

6. **Sindora leiocarpa** Backer *ex* de Wit

(Greek, *leio-* = smooth, *karpos* = fruit; the smooth pods)

Bull. Bot. Gard. Buitenz. 3, 18 (1949) 58; Cockburn *l.c.* 181; Anderson *l.c.* 239; Whitmore, Tantra & Sutisna *l.c.* 207; Kessler & Sidiyasa *l.c.* 74; Ding Hou *l.c.* (1996) 702; Coode *et al.* (eds.) *l.c.* 164; Argent *et al.* (eds.) *l.c.* 374. **Type:** *Grashoff 667*, Sumatra, Kubulands (holotype L).

Tree up to 45 m tall, 80 cm diameter. **Bark** smooth, finely cracked or fissured, red-brown, grey-mottled, or black; inner bark yellowish brown, brown, red, fibrous and brittle. **Sapwood** white or yellow. **Stipules** lanceolate, 3–5 mm long, caducous. **Leaves** *each with (2–)3(–4) pairs of leaflets*; petiole 1.5–2.8 cm and rachis 4–11 cm long, both minutely puberulous, glabrescent, or almost glabrous. **Leaflets** *glabrous on both surfaces*, *except sometimes sparsely hairy on the midrib of lower surface*; elliptic, obovate-elliptic or broadly elliptic, 2.5–5(–9.5) × 2–3(–5) cm, base obtuse or cuneate, slightly asymmetrical, *apex obtuse*, *acute*, *or shortly acuminate*, *sometimes slightly emarginate*, *without a gland at the tip on the undersurface*. **Inflorescences** paniculate, up to 16(–25) cm long; both rachis and branches densely pubescent; bracts and bracteoles ovate, up to 4 mm long, densely puberulous; pedicel 1–1.5 mm long, densely puberulous. **Flowers** yellow, yellowish brown; *calyx lobes* elliptic or elliptic-oblong, obovate, or ovate, *4.5–5(–6) × 2–3(–3.5) mm*, *without spiny outgrowths on the outer surface*, *densely puberulous outside*, *appressed hairy inside*; *petals* slightly oblong, 5–6 mm long, slightly longitudinally folded and somewhat bent inward from the middle, *the lower half (claw) densely puberulous outside and glabrous inside*, the upper half (limb) glabrous except for the villose margins; stamens: *free filaments and staminodes* up to 7 mm long, *ciliate*; *ovary c.* 2 mm long, *densely woolly along the margins*, style 8–10 mm long. **Fruits** ellipsoid, ovoid, broadly ovoid, or suborbicular, 5–9 × 4.5–5.8 cm, flattened, *smooth*, *almost glabrous*, *1–3-seeded*. **Seeds** broadly ovoid or suborbicular, *c.* 1.3(–2.1) cm long, smooth, black; *aril broader than high*, *often larger than the seed*, *smooth or rugose*.

Vernacular names. Sabah—*sepetir*, *sepetir paya* (Malay). Sarawak—*ensurut*, *tampar hantu, tampar hantu paya* (Iban).

Distribution. Sumatra and Borneo. In Sabah recorded for Beaufort, Kinabatangan, Lahad Datu, Sandakan, and Tawau districts; in Sarawak throughout. Also in Brunei and Kalimantan.

Ecology. In lowland, well-drained or seasonal freshwater swamp forests, on sandy loam soils, usually below 100 m altitude, rarely up to 400 m. Flowering in January, March–June, and August–December; fruiting in March–May and August–December.

Uses. The wood is used for making boards, partition walls and household utensils.

7. **Sindora velutina** Baker

(Latin, *velutinus* = velvety; the densely hairy branchlets and leaf under surface)

In Hooker *f.*, Fl. Brit. Ind. 2 (1878) 269; Prain *l.c.* (1897) 205 & 482; Ridley *l.c.* (1922) 638; Merrill *l.c.* (1929) 99; Masamune *l.c.* 353; de Wit *l.c.* (1949) 72; Whitmore *l.c.* 273; Meijer *l.c.* 195; Cockburn *l.c.* 181; Anderson *l.c.* 239; Whitmore, Tantra & Sutisna *l.c.* 207; Turner *l.c.* 310; Ding Hou *l.c.* (1996) 707; Argent *et al.* (eds.) *l.c.* 374. **Type:** *Maingay 607*, Peninsular Malaysia, Malacca (holotype

K). **Synonyms:** *S. mucronata* Pierre, Fl. For. Coch. (1899) *sub t.* 385; *S. parvifoliola* Symington, Kew Bull. (1938) 77.

Tree up to 54 m tall, 95 cm diameter; buttresses very short. **Bark** smooth to slightly cracking with horizontal rings, greyish white, brown or dark purplish brown; inner bark white, brown or red-brown, firmly fibrous or laminated, granular at the edge. **Sapwood** white or cream colour, fairly hard, heartwood dark brown. Branchlets glabrous to densely tomentose. **Stipules** lanceolate, *c.* 8 mm long, caducous. **Leaves** *each with (3–)5–6 (–7) pairs of leaflets*; petiole 2–3(–5) cm long and rachis 5–16(–22.5) cm long, both tawny woolly or densely tomentose when young and later thinner. **Leaflets** upper surface glabrous, rarely sparsely hairy near the midrib, *lower surface usually densely tawny hirsute*, *sometimes slightly glabrescent*; ovate-elliptic or elliptic, sometimes ovate or broadly ovate, 3–9(–14.5) × 1.5–4.5(–7.5) cm, base rotund or obtuse, usually symmetrical, *apex shortly or normally acuminate*, *sometimes acute*. **Inflorescences** paniculate, up to 11(–20) cm long; both rachis and branches densely brown-hirsute; bracts lanceolate, *c.* 3 × 1.5 mm, densely appressed hirsute outside; bracteoles resembling bracts but about half the length; pedicel very short. **Flowers:** *calyx lobes* oblong-lanceolate, 11–13 mm long, *unarmed*, *densely hirsute often on both surfaces*; *petals* narrowly lanceolate, 10–12 mm long, *densely woolly outside, glabrous inside*; stamens: *free filaments and staminodes* up to 1.5 cm long, *hirsute towards the lower 1/2–1/3*; *ovary c.* 3 mm long, *woolly*, with many minute outgrowths, style up to 15 mm long. **Fruits** elliptic-ovate or broadly ovate, slightly irregular in shape, 6–11.7(–15) × 5–6.5(–8) cm, *with rather small*, *scattered*, *moderately developed sharp spines* (*c.* 4 mm long), *with fine warts among them*, *1–4-seeded*. **Seeds** irregularly ovoid, 1.6–2.2 cm across, flattened, smooth, purple-black, almost glossy; *aril longer than wide* (*c.* 2.6 cm wide).

Vernacular name. Sabah—*sepetir* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah known from Sandakan, Lahad Datu and Tawau districts; in Sarawak recorded for Bintulu district. Also in Brunei.

Ecology. In forest on dryland, hillsides, rarely along riverbanks and in swamps, growing usually scattered, in low altitude usually below 100 m, sometimes up to 360 m. Flowering in March–May, July, and October–November; fruiting in February, May–June, September, and November–December.

Uses. The wood is said to be soft and subject to attack by termites and other insects. It splits when drying. It is used as beams and rafters for house-building and for household utensils and boards. (*cf.*: Foxworthy, Mal. For. Rec. 3 (1927) 92; K. Heyne, Nutt. Pl. Ned.-Ind. 1 (1950), 729; Burkill, EPMP 2 (1966) 2070; de Wit, Bull. Bot. Gard. Buitenz. 3,18 (1949) 76).

8. **Sindora wallichii** Benth. Fig. 12.

(N. Wallich, 1786–1854, former Superintendent of the Calcutta Botanic Garden, India)

In Hooker, Icon. Pl. 11 (1867) sub *t.* 1018, *excl. t.* 1017; Prain *l.c.* (1897) 203 & 481, as *S. wallichiana*; Ridley *l.c.* (1922) 637; Symington *l.c.* (1938) 75 & 77; de Wit *l.c.* (1949) 76; Whitmore *l.c.* 273; Cockburn *l.c.* 181; Keng *l.c.* (1990) 39; Whitmore, Tantra & Sutisna *l.c.* 207; Kessler & Sidiyasa *l.c.* 74; Turner *l.c.*

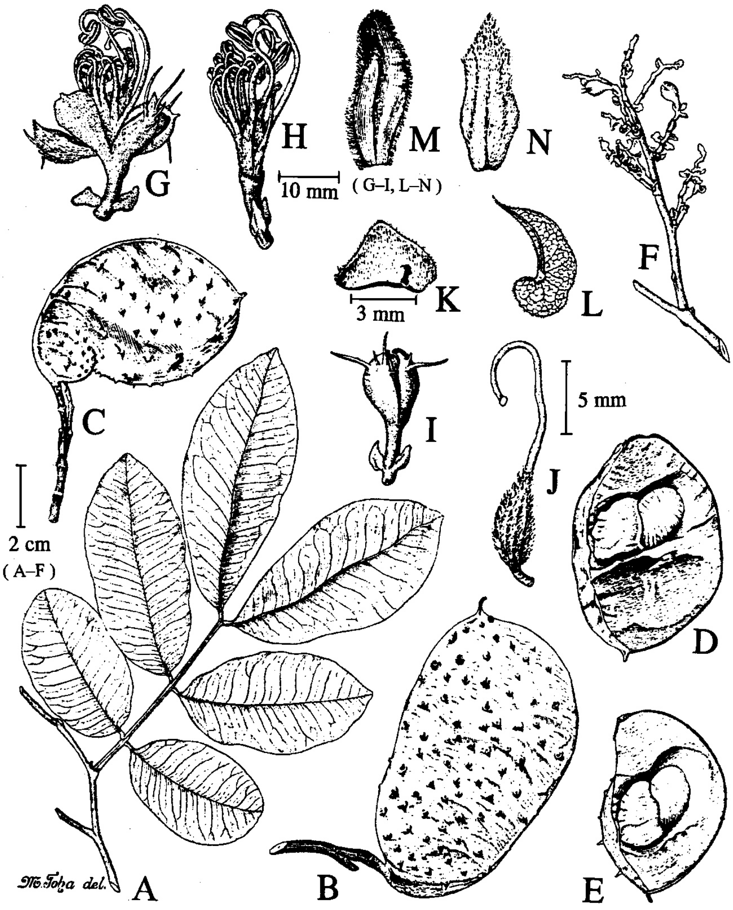

Fig. 12. *Sindora wallichii*. A, leafy twig; B–C, spiny fruits; D–E, two valves of opened fruits, showing arillate seeds; F, inflorescence; G, flower; H, flower with calyx and petal removed; I, flower bud bearing some spiny outgrowths; J, pistil; K, bracteole; L, stipule. (After Bull. Bot. Gard. Buitenz. 3, 18 (1949) 79, f. 15.)

310; Ding Hou *l.c.* (1996) 708; Loo & Tan *l.c.* 99; Argent *et al.* (eds.) *l.c.* 374. **Lectotype** (de Wit, 1949)**:** *Wallich 5805*, Singapore (holotype K; isotype BM). **Synonyms:** *S. wallichii* Benth. var. *intermedia* Baker *in* Hooker *f.*, Fl. Brit. Ind. 2 (1878) 268; *S. intermedia* (Baker) Prain *l.c.* (1897) 204 & 482, Ridley *l.c.* (1922) 638, *p.p.*

Tree up to 35 m tall, 80 cm diameter; bole straight; buttresses steep. **Bark** smooth, grey or dark grey; inner bark yellow, mottled. **Stipules** foliaceous, up to 15 mm long, tardily caducous. **Leaves** *each with 3 or 4 pairs of leaflets*; petiole 1.2–2.5 cm and rachis 4.5–8.5 cm long, minutely puberulous, glabrescent, or sometimes glabrous in the upper half. **Leaflets** upper surface glabrous, sometimes puberulous in the lower half or very minutely puberulous all over, *lower surface puberulous to densely pubescent*; elliptic-ovate or elliptic-oblong, ovate-oblong or obovate-oblong, 4–10.5 × 2.5–5 cm, upper pair usually the largest, base obtuse or rotund, often more or less unequally sided, *apex acute*, *subacuminate*, *obtuse*, *the very tip slightly notched*. **Inflorescences** paniculate, up to 24 cm long, both rachis and branches densely puberulous; pedicel very short. **Flowers:** *calyx lobes lanceolate*, to *9.5 × 3 mm*, *outside puberulous and bearing some distinctly spiny outgrowths often in the upper half*, *insides glabrous*; *petals* elliptic or oblong-elliptic, *c.* 8 × 2–2.5 mm, *outside woolly*, *inside glabrous*; stamens: *free filaments* up to 10 mm long, *slightly hairy at the lower part*; *ovary c.* 5 mm long, *densely hairy*, *with many minute*, *spiny outgrowths*, *2–4-ovuled*, style up to 10 mm long. **Fruits** *suborbicular*, *broadly obovoid or ellipsoid*, *6–10 × 4–6 cm*, flattened, *covered with close, hard, straight spines (up to 5 mm long)*, 1–2(–3)-seeded. **Seeds** suborbicular, *c.* 2 cm in diameter; *aril often broader than long*.

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah known from Keningau, Lahad Datu, Sandakan, and Tawau districts; not recorded in Sarawak. Also in Kalimantan.

Ecology. In lowland forests, on well-drained sandy or sometimes clayey soils, sometimes near mangrove swamp, often below 100 m, sometimes up to 300 m altitude. Flowering in March, May, July, and October–December; fruiting in January, March, August, October, and December.

13. **SYMPETALANDRA** Stapf

(Greek, *sum-* or *sun-* = joined, *petalon* = petal, *andros* = male; flower with petals and stamens joined at the base)

In Hooker, Icon. Pl. 4, 28 (1905) *t.* 2721; Whitmore, TFM 1 (1972) 273; Steenis, Blumea 22 (1975) 162; Cockburn, TS 1 (1976) 183; Anderson, CLTS (1980) 239; Polhill & J.E. Vidal *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 95; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 208; Ding Hou, FM 1, 12 (1996) 709; Argent *et al.* (eds.), MNDT-CK 2 (1997) 379.

Trees *unarmed*; buttresses present. **Stipules** *minute*, *caducous*. **Leaves** *compound*, *once pinnate and paripinnate with (1–)2(–3) pairs of leaflets*, *or bipinnate with 1–3 pairs of pinnae*, *each pinna with 1–6 pairs of leaflets*. **Leaflets** pellucid-punctate. **Inflorescences** axillary and/or terminal, *racemose*, *simple or fascicled*, *or paniculate*; bracts persistent beyond anthesis; bracteoles absent at anthesis. **Flowers** *bisexual*, *calyx and corolla pellucid-glandular*; *hypanthium obscure or absent*; calyx 5-lobed; *petals 5*, *2.5–5 mm long*; *stamens 10*, *alternately long and short*, *joined with petals at the base*, *filaments glabrous*, *anthers with a large*, *dorsal*, *dark brown connective*, *and a deciduous gland at apex*, glabrous or slightly hairy on the dorsal connective; *ovary hairy*, *2–6-ovuled*. **Fruits** *woody*, *smooth outside*, *dehiscent and 2-valved*, compressed, prominently veined, 1–4-seeded; *valves straight or only slightly twisting during dehiscence*. **Seeds** orbicular to broadly ellipsoid, compressed but thick, 3–3.5 cm diameter, *not arillate*.

Distribution. A genus comprising 5 species, distributed in Sumatra, Peninsular Malaysia, Borneo, Lesser Sunda Islands (Flores), and the Philippines. Two species in Sabah and Sarawak.

Key to *Sympetalandra* species

Leaves once pinnate. Inflorescence rachis glabrous. Anthers slightly hairy on the dorsal connective. Ovary 2-ovuled..**1. S. borneensis**
Leaves bipinnate (some leaves once-pinnate in juvenile state). Inflorescence rachis pubescent. Anthers not hairy. Ovary 3–6-ovuled...**2. S. unijuga**

1. **Sympetalandra borneensis** Stapf
(of Borneo)

In Hooker, Icon. Pl. 4, 28 (1905) *t*. 2721; Merrill *l.c*. (1921) 295, *l.c*. (1929) 98; Masamune *l.c*. 354; Whitmore, *l.c*. 274; Steenis *l.c*. (1975) 163; Anderson *l.c*. 239; Whitmore, Tantra & Sutisna *l.c*. 208; Ding Hou *l.c*. (1996) 710; Argent *et al*. (eds.) *l.c*. 379. **Type:** *Haviland & Hose 1628*, Borneo, Sarawak, Kuching (holotype K; isotypes L, SAR).

Tree up to 25 m high, 25 cm diameter; buttresses up to 0.8 m high, 90 cm wide, 15 cm thick. **Leaves** *once pinnate*, *each with (1–)2(–3) pairs of leaflets*; petiole 4.5–7 cm long and rachis 2.5–3.5 cm long, both glabrous. **Leaflets** elliptic, 6–17 × 3–7 cm. **Inflorescences** axillary and extra-axillary, *densely racemose*, up to 14 cm long, *both peduncle and rachis glabrous*; bracts ovate, *c*. 1 mm long; pedicel very short. **Flowers:** calyx *c*. 1.5 mm long, glabrous outside; lobes triangular or crescent, 0.3–0.5 mm long; petals oblong or slightly obovate-oblong, 2.5–3.5 × 1.5 mm; stamen filaments 3–4 mm long, glabrous, *anthers c*. 0.6 mm long, *slightly hairy at the upper half of dorsal connective*; *ovary 2-ovuled*. **Fruits** unknown.

Vernacular name. Sabah—*merbau lalat* (preferred name).

Distribution. Endemic to Borneo. In Sarawak confined to coastal areas, throughout; so far erroneously recorded for Sabah (see treatment under next species).

Ecology. In forests, including *kerangas* forest, at low and medium altitude. Flowering in March–April, and September–October.

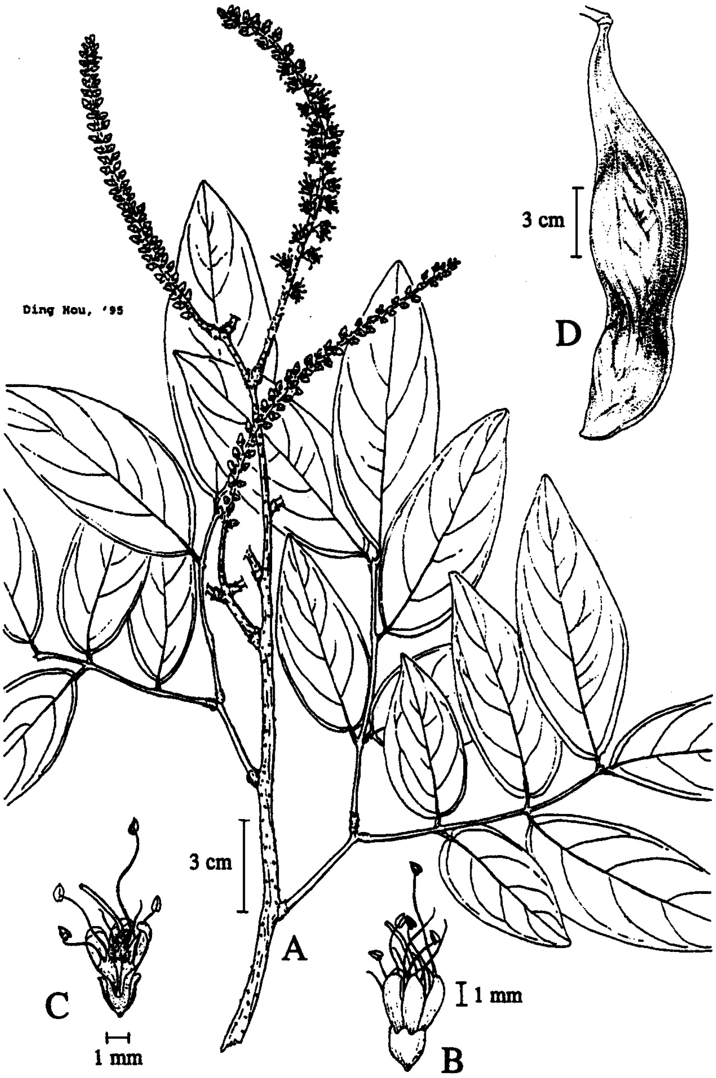

Fig. 13. *Sympetalandra unijuga*. A, flowering leafy twig; B, flower; C, flower in longitudinal section; D, fruit. (A–C after FM 1, 12 (1996) 712, f. 51 a–c, D after Cockburn, TS (1976) 183, part of f. 32.)

2. **Sympetalandra unijuga** (Airy Shaw) Steenis Fig. 13.

(Latin, *uni-* = one, *-jugum* = paired; leaf with one pair of leaflets)

Blumea 22 (1975) 163; Whitmore, Tantra & Sutisna *l.c.* 208; Turner *l.c.* 311; Ding Hou *l.c.* (1996) 713. **Basionym:** *Erythrophleum unijugum* Airy Shaw, Kew Bull. (1939) 180. **Type:** *Agullana 1780*, Borneo, Sabah (holotype K; isotype L). **Synonyms:** *Erythrophleum densiflorum auct. non* (Elm.) Merr.: Merrill *l.c.* (1921) 295, *l.c.* (1929) 98; *S. borneensis auct. non* Stapf: Kostermans, Gard. Bull. Sing. 17 (1958) 5, *p.p.*, Cockburn *l.c.* 183; *Serianthes gigalobium* Kosterm., Reinwardtia 2 (1953) 357.

Tree up to 30 m tall, 70 cm diameter; buttresses up to 4 m high, extending up to 100 cm from the trunk. **Leaves** *bipinnate* (some leaves once pinnate in juvenile state), *with 1 (2 or 3) pair(s) of pinnae*, *each pinna with (2–)3–4(–5) pairs of leaflets*; petiole 2–5(–8) cm long; main rachis 6–10 cm long; stalk of pinnae 2–5 cm long; rachis of pinnae 6–15(–18) cm long. **Leaflets** ovate-oblong to oblong-elliptic, 6–10(–17) × 2–4(–8) cm, base more or less rounded, *apex acuminate*; petiolules 3–5 mm long. **Inflorescences** *racemose and paniculate*, up to 10 cm long, *rachis loosely to densely hairy*; pedicel very short. **Flowers:** calyx lobes not ciliate; petals yellowish white; *anthers glabrous*; *ovary 3–6-ovuled*. **Fruits** *falcate*, 15–36 × 3.5–4(–5) cm, coarsely and prominently reticulate-veined; *pericarp woody*, *c. 2 mm thick*. **Seeds** 1–5 per fruit, *c.* 4 × 2.5 × 2 cm, even larger in 1-seeded pods.

Vernacular name. Sabah—*merbau lalat* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Sabah widespread; in Sarawak rare.

Ecology. In well-drained forests, from lowland up to 600 m altitude. Flowering in April–May, June and September; fruiting in July and September–November.

14. **UITTIENIA** Steenis

(H.Uittien, 1898–1944, botanist,
formerly curator of the Utrecht Herbarium, the Netherlands)

Bull. Bot. Gard. Buitenz. 3, 17 (1948) 416; Hutchinson, Gen. Fl. Pl. (1964) 237; Irwin & Barneby *in* Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 101 (as syn. of *Dialium*); Ding Hou, FM 1, 12 (1996) 714. **Synonym:** *Dialium* subgen. *Uittienia* (Steenis) Steyaert, Reinwardtia 2 (1953) 355.

Trees. **Stipules** minute, linear, caducous. **Leaves** *unifoliolate*; *petiole thickened at basal end*; *petiolules very short*, *wrinkled*. **Inflorescences** axillary, *fascicled short-thyrses*. **Flowers:** *hypanthium obscure or 0*; *calyx lobes 5*; *petals 5*; *disk distinct*, *cushion-like*, *hairy*; *stamens 5(–7)*, *all fertile*, rarely 1–3 smaller; *ovary* slightly hairy, *1-ovuled*. **Fruits** *not winged*, *drupaceous*, *indehiscent*, globose, woody, *with a crustaceous*, *glabrous exocarp united with a thick*, *hard mesocarp* around the single subglobular seed; endosperm almost filling the seed; embryo minute, conical.

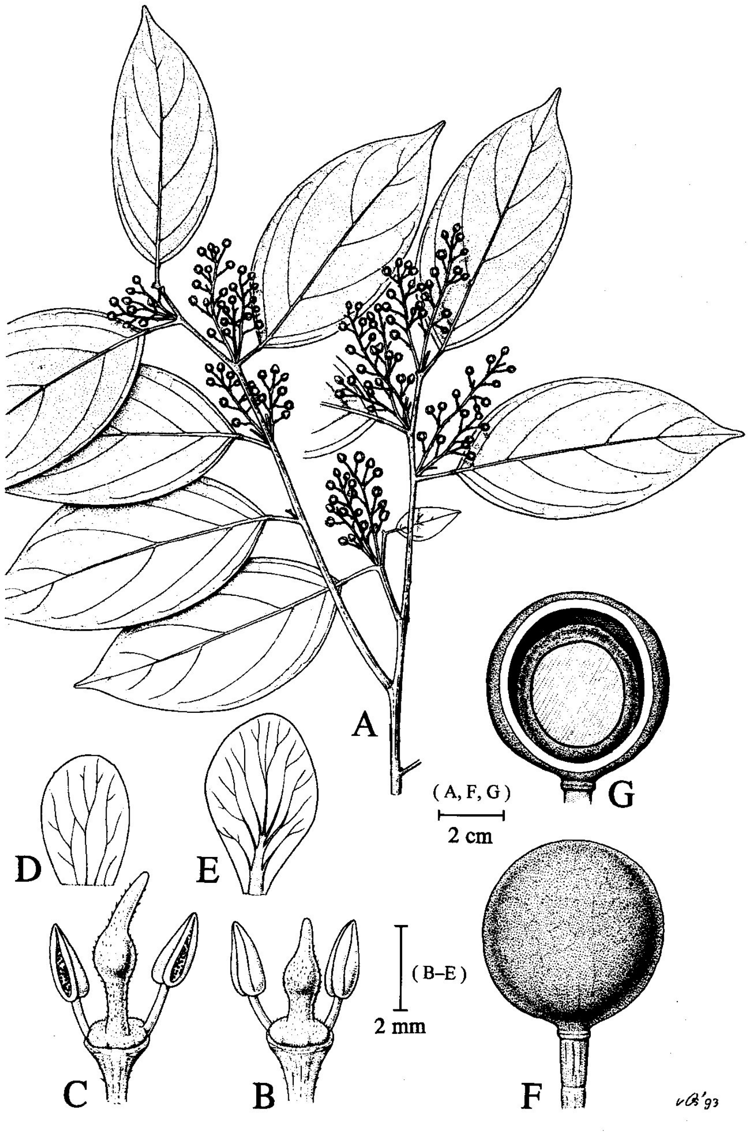

Fig. 14. *Uittienia modesta.* A, flowering leafy twig; B–C, young and old flowers with calyx lobes, petals, and 2 or 3 stamens removed; D, calyx lobe; E, petal; F, fruit; G, fruit in longitudinal section. (After FM 1, 12 (1996) 715, f. 52.)

Distribution. Only 1 species known in Sumatra and Borneo. In Sabah only known from Tawau district; not yet found in Sarawak. Also in Kalimantan.

Ecology. In primary forest, up to 400 m altitude.

Uittienia modesta Steenis Fig. 14.

(Latin, *modestus* = modest; alluding the modest personality of Uittien)

Bull. Bot. Gard. Buitenz. 3, 17 (1948) 418; Whitmore, Tantra & Sutisna *l.c.* 208; Ding Hou *l.c.* (1996) 714. **Type:** *bb 19274*, Borneo, E Kalimantan (holotype BO; isotype L). **Synonym:** *Dialium modestum* (Steenis) Steyaert, Reinwardtia 2 (1953) 355.

Tree up to 40 m tall, 100 cm diameter; buttresses up to 5 m high, extending outward 100–200 cm. **Leaves** glabrous; petiole 0.8–2 cm long. **Leaflets** ovate to ovate-oblong, elliptic or lanceolate, 7–20 × 3.5–7.5 cm; base obtuse or rounded, *apex acuminate*; lateral veins 4–7 per side; intercostal venation loosely reticulate, obscure or visible on both surfaces; petiolules very short. **Inflorescences** with rachis or branches up to 7 cm long, sparsely puberulous; bracts and bracteoles minute, deciduous. **Flowers:** calyx lobes oblong or ovate, 3.5 × 1.5–2 mm; *petals subequally obovate*, 4–6 × 2–3 mm, *glabrous*, *distinctly pinnately nerved with a strong midrib*; disk *c.* 2 mm diameter; *stamen filaments glabrous*. **Fruits** *often only one developed from an inflorescence*, *on a thickened woody stalk* (*c.* 1 cm diameter), *c.* 6 cm diameter, *with a roughish*, *somewhat scurfy-granular brown surface*, glabrous; pericarp rather hard and thick (4–5 mm). **Seed** *one in each fruit*, subglobose, *c.* 4 cm diameter.

Distribution. Sumatra and Borneo. In Sabah known for Tawau district; not recorded in Sarawak. Also in Kalimantan.

Ecology. In primary forest, often occurring below 100 m altitude, sometimes up to 400(–600) m. Flowering in April, June–July, and November; fruiting in June–July and September–October.

MORACEAE

K.M. Kochummen†[1] **& Rusea Go**[2]
(Edited with the assistance of Dr. C.C. Berg)

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Lindley, Veg. Kingd. (1847) 266; Merrill, EB (1921) 217; Ridley, FMP 3 (1924) 317 (under Urticaceae); Masamune, EPB (1942) 238; Browne, FTSB (1955) 348 (under Urticaceae); Backer & Bakhuizen *f.*, FJ 2 (1965) 12; Corner, Gard. Bull. Sing. 19 (1962) 187, WSTM 3rd. edition 2 (1988) 509; Burgess, TBS (1966) 399; Kochummen, TFM 3 (1978) 119; Anderson, CLTS (1980) 254; Primack, Forester's Guide to the Moraceae of Sarawak (1983) 2; Rohwer *in* Kubitzki *et al*. (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 438; Kessler & Sidiyasa, Trees of the Balik Papan-Samarinda Area, East Kalimantan (1994) 172; Turner, Gard. Bull. Sing. 47 (1995) 347; Coode *et al*. (eds.), CLBD (1996) 210; Argent *et al.* (eds.), MNDT-CK 2 (1997) 429.

Dioecious or monoecious trees, shrubs, climbers, stranglers, epiphytes or herbs *with white or rarely pale yellow-brown latex* (except some species of *Streblus*); bole (if present) with or without buttresses. **Bark** smooth, rough, fissured or scaly, often lenticellate, sometimes spiny. **Buds** small to very large. **Stipules** small or large, *sometimes connate to form a cap over the bud*. **Twigs** glabrous or hairy, slender or stout, *often with ring-like scars of fallen stipules*. **Leaves** *alternate* (distichous or spiral), very rarely subopposite or subverticillate; *simple*, *entire*, *lobed*, or *deeply incised down to the midrib*, or rarely compound-imparipinnate; *pinnately veined* or with distinct basal pair(s) of lateral veins; margin plane, revolute or faintly toothed. **Inflorescences** axillary, or on older branches or trunk, or borne on runners/stolons arising from the base of stem, *unisexual or bisexual*, paniculate, racemose, spicate, *capitate or urceolate*. **Flowers** small, *unisexual* or very rarely bisexual; *perianth usually with (0–)4(–10) free or fused*, *valvate or imbricate*, *persistent tepals* (= perianth lobes). **Male** (staminate) **flowers** *with (1–)4(–8) stamens opposite the tepals*, *filaments free or united*, *straight or inflexed in bud*, anthers small, mucronate or bilobed, varying in shape from crescentic to turbinate (with transverse equatorial dehiscence); pistillode (rudimentary pistil) present or absent. **Female** (pistillate) **flowers** *without staminodes* (rudimentary stamens); *ovary unilocular*, very rarely 2-locular, *superior or inferior or immersed in sockets of the inflorescence axes*, *styles 2 or 1*, *stigmas 2 or 1*, *not capitate or peltate*; *ovule 1*, *anatropous or campylotropous*, *apical or subapical*. **Fruits** *drupaceous* or in *Ficus* very often dry and achene-like, simple and often *enclosed in an urn-shaped receptacle* (*syconium*, in *Ficus*) *or united into a large fleshy compound structure called syncarp* (= multiple fruit), *with the persistent perianth becoming enlarged*, *fleshy* (and edible in several *Artocarpus* species). **Seeds** large or small, *testa membranous* or disintegrated; endosperm present or absent; *embryo curved or straight*, radicle long or short, cotyledons plicate, conduplicate or plane, foliaceous or thickened, equal or unequal.

Distribution. About 37 genera with *c*. 1050 species, mostly in the tropics. Eight genera with 179 species are recorded for Sabah and Sarawak.

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Ecology. Occurs in a wide variety of habitats and forest types from lowland to upper montane forests up to 3200 m altitude. The flowers are either wind- or insect-pollinated (agaonid wasps, stingless bees, flies, and a few others). Fruits are dispersed by birds, bats and a variety of terrestrial and arboreal mammals.

Uses. Several members of the family, e.g., species of *Antiaris*, *Artocarpus*, and *Parartocarpus*, produce valuable timber. Fruits of a number of species of *Artocarpus* (e.g., *A. altilis, A. heterophyllus*, *A. integer, and A. odoratissimus*) are edible, and the trees are commonly cultivated in village orchards or occasionally in large scale commercial plantation. The leaves of mulberry tree (*Morus alba*), a native of China, are a source of food for silkworms. Many species of *Ficus* have potential for use in landscaping while some others are used in traditional medicine. The latex of *Antiaris* and *Parartocarpus* species is poisonous and used by the aborigines for making arrow poison. Bark of *Antiaris* and certain species of *Artocarpus* are used in making cloth.

Taxonomy. The Moraceae are closely related to the Ulmaceae and Urticaceae but differ from both in having latex, stigma not capitate or peltate, ovule anatropous or campylotropous, and in the more or less connate large fleshy multiple fruits. In the more recent system of classification (Rohwer, 1993), the family is classified into 5 tribes, viz. the Artocarpeae, Castilleae, Dorstenieae, Ficeae and Moreae. The disposition of the eight genera occurring in Sabah and Sarawak is as follows:

Tribe Artocarpeae : *Artocarpus, Parartocarpus, Prainea*
Tribe Castilleae : *Antiaris*
Tribe Dorstenieae : No representative
Tribe Ficeae : *Ficus*
Tribe Moreae : *Maclura*, *Streblus*, *Trophis*

Key to the genera

(for fertile specimens)

1. Flowers enclosed inside urceolate receptacles or syconia.......................................**3. Ficus**
   Flowers not enclosed inside syconia..2

2. Male flowers in spicate inflorescences..3
   Male flowers usually in capitate or sometimes paniculate inflorescences.......................4

3. Shrubs or trees...**6. Streblus**
   Climbers...

Trophis P. Br., *nom. conserv*.

Nat. Hist. Jamaica (1756) 357; Corner, Gard. Bull. Sing. 19 (1962) 230; Berg, Proc. Kon. Ned. Ak. C 91 (1988) 352; Rohwer *in* Kubitzki *et al*. (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 446. Synonyms: *Olmedia* Ruiz & Pav., Prod. (1798); *Malaisia* Blanco, Fl. Filip. (1837) 789, Corner *l.c.* (1962) 240, Backer & Bakhuizen *f. l.c.* 15; *Cephalotrophis* Blume, Mus. Bot. Lugd.-Bat. 2 (1856) 75.

About 9 species, in tropical America, Madagascar, Réunion, and Asia.

Dioecious, *unarmed twining climbers* (in Sabah), or trees or shrubs (outside Sabah and Sarawak) *with white latex*. *Leaves simple*, *distichous*, *pinnately veined*; *stipules free*, *lateral*. *Male* *inflorescences spicate* with sterile abaxial grooves; female ones almost capitate; bracts linear to spathulate, incurved. Male flowers 3–4-merous, tepals valvate, joined at the base; filaments inflexed in bud; pistillode minute. Female flowers: perianth utricular, obscurely 4-lobed; style with 2(–1) long stigmatic arms. *Fruits* (*syncarps*) *fleshy*, set with few projecting drupes, enclosed in a perianth.

In Sabah and Sarawak, represented by one species, *T. scandens* (Lour.) Hook. & Arn. (basionym: *Malaisia scandens* Lour.), which is rare and known so far by one collection, *SAN 8393*, from Keningau district in Sabah.

4. Climbing plants with axillary spines………………………………………………….……...

Maclura Nutt., *nom. conserv.*

Gen. N. Amer. Pl. 2 (1818) 233; Corner *l.c.* (1962) 235; Backer & Bakhuizen *f. l.c.* 17; Berg *l. c.* (1988) 352; Rohwer *l.c.* 446.

About eleven species, mainly found in the tropics, with one species in N America.

Dioecious climbers (in Sabah), or scrambling shrubs or trees (outside Sabah and Sarawak), *usually with axillary spines and white latex*. *Leaves simple, spirally arranged or distichous, pinnately veined*; *stipules free, lateral*. *Male inflorescences paniculate*, with a sterile groove, or *capitate*; female ones capitate or shortly spicate; bracts spathulate to clavate or absent. Male flowers 4-merous; tepals free; anthers extrorse to laterally dehiscent, filaments inflexed or straight in bud; pistillode subulate or absent. Female flowers sessile, free or connate proximally; tepals 4, decussate, free or fused to the middle; *ovary free or sunken in sockets of the receptacle*; stigmatic arms 1–2, short or long. *Fruits simple*, *drupaceous*, very thinly pulpy, enclosed in the fleshy perianth, mostly not projecting, often concrescent below into a fleshy syncarp.

In Sabah one species, *M. cochinchinensis* (Lour.) Corner, very rare, known only by one collection, *J.H. Beaman 7932*, from Mt. Kinabalu.

Shrubs or trees........…………………………………………………….....…………..5

5. Styles 2. Fruits simple, one-seeded..........………………………………..….……**1. Antiaris**
Style 1. Fruits many-seeded syncarps (= multiple fruits)..........……………………………..6

6. Stamens 2–3. Capitate inflorescences with distinct and persistent involucre of bracts at the base. Bark with abundant large lenticels...………………………...……...**4. Parartocarpus**
Stamen 1. Capitate inflorescences without distinct involucre of bracts at the base. Bark without large lenticels......………………………………………...................…………7

7. Dioecious trees. Male and female inflorescences similar in shape. Drupes projecting out from the syncarps..........…………………………….....………………………….**5. Prainea**
Monoecious trees. Male and female inflorescences different in shape. Drupes immersed in the syncarps..........…………………...………………....……………..………...**2. Artocarpus**

Forest key to the genera

(based mainly on field and vegetative characters)

1. Tall forest trees..........……………………………………..…………………....…………2
Shrubs, small trees, climbers, creepers, epiphytes, or stranglers........……….........…………7

2. Flowers enclosed in a syconium..**3. Ficus** (in part)
   Flowers not enclosed in a syconium..3

3. Fruits many-seeded syncarps, often prickly..4
   Fruits simple, one-seeded, with smooth surface..6

4. Bark with abundant large lenticels. Capitate inflorescences with persistent involucre of bracts..**4. Parartocarpus**
   Bark without large lenticels. Capitate inflorescences without persistent involucre of bracts..5

5. Dioecious trees. Drupes projecting out of the syncarp surface. Leaves with prominently looping lateral veins..**5. Prainea**
   Monoecious trees. Drupes immersed in the syncarp surface. Leaf lateral veins not prominently looping..**2. Artocarpus**

6. Leaves hairy. Inflorescences discoid-capitate..**1. Antiaris**
   Leaves glabrous. Inflorescences spicate..**6. Streblus** (in part)

7. Shrubs or small trees..8
   Climbers, creepers, epiphytes or stranglers..9

8. Flowers enclosed in a syconium..**3. Ficus** (in part)
   Flowers not enclosed in a syconium..**6. Streblus** (in part)

9. Stem spiny..**Maclura**
   Stem not spiny..10

10. Flowers enclosed in a syconium..**3. Ficus** (in part)
    Flowers not enclosed in a syconium..**Trophis**

1. **ANTIARIS** Lesch., *nom. conserv.*

(from the Indonesian plant name *antjar*)

ipoh (Iban, Malay)

Rusea Go

Ann. Mus. Hist. Nat. Paris 16 (1810) 476; Merrill, EB (1921) 220; Ridley, FMP 3 (1924) 350; Masamune, EPB (1942) 238; Corner, Gard. Bull. Sing. 19 (1962) 244, WSTM 3rd. edition 2 (1988) 510; Backer & Bakhuizen *f.*, FJ 2 (1965) 19; Berg, Bull. Jard. Bot. Etat. 47 (1977) 308; Kochummen, TFM 3 (1978) 120; Anderson, CLTS (1980) 254; Primack, Forester's Guide to the Moraceae of Sarawak (1983) 13; Whitmore, Tantra & Sutisna, CLK 2,1 (1990) 236; Rohwer *in* Kubitzki *et al.* (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 450; Coode *et al.* (eds.), CLBD (1996) 210; Argent *et al.* (eds.), MNDT-CK 2 (1997) 429; PROSEA 5, 3 (1998) 73. **Synonyms:** *Ipo* Pers., Syn. Pl. 2 (1807) 566; *Antcha* Horsfield, Verh. Bat. Gen. 7 (1814) 8; *Toxicaria* Aepnel *ex* Steud., Nomencl. Bot. (1821) 434; *Lepurandra* Graham, Cat. Pl. Bombay (1839) 193.

Monoecious or deciduous trees, *without spines*. **Bark** smooth, grey; *sap creamy white and watery, turning dirty brownish and granular on exposure.* **Stipules** *free*, subamplexicaul (slightly clasping the twig). **Leaves** *distichous*, *pinnately veined*, base rounded or cordate. **Inflorescences** *unisexual*, axillary, the females solitary, the males in groups of 2–4, or the males below a single female in the leaf axil. **Male inflorescences** *discoid-capitate*, pedunculate, many-flowered, involucrate with small bracts arranged in a single series; interfloral bracts absent. **Male flowers** sessile; tepals 4–5, minute, free, imbricate; stamens (3–)4(–8), filaments very short or almost none, anthers introrse; pistillode absent. **Female inflorescences** 1(–2)-flowered, sessile or pedunculate; bracts small, few, scattered. **Female flower** with 4–5 minute tepals; ovary (sub)inferior, concrescent with the receptacle, *style very short*, *with 2 long stigmatic arms*; ovule immersed, apical, transversely anatropous. **Fruits** *simple*, *drupaceous*, globose to ellipsoid or pear-shaped, surface velvety, fleshy; endocarp thinly crustaceous. **Seeds** rather large; embryo straight, radicle very short, cotyledons thick, equal, not folded.

Distribution. One variable species, found throughout the Old World tropics, ranging from tropical Africa to Madagascar, Yemen, Sri Lanka, India, Burma, Thailand, Indo-China, S China, throughout the Malesian region, Australia, and Tonga.

Antiaris toxicaria Lesch. Fig. 1.
(Latin, *toxicarius* = poisonous; the latex)

Ann. Mus. Hist. Nat. Paris 16 (1810) 478, *t.* 22; Merrill *l.c.* (1921) 220; Ridley *l.c.* (1924) 350; Masamune *l.c.* 238; Corner *l.c.* (1962) 244, *l.c* (1988) 510; Backer & Bakhuizen *f. l.c.* 20; Kochummen *l.c.* 120; Anderson *l.c.* 254; Primack *l.c.* 13; Whitmore, Tantra & Sutisna *l.c.* 236; Turner, Gard. Bull. Sing. 47 (1995) 347; Coode *et al.* (eds.) *l.c.* 210; Argent *et al.* (eds.) *l.c.* 429.

Tree up to 50 m tall, 100 cm diameter, often deciduous; buttresses 1–3 m high. **Bark** greyish white, smooth to slightly fissured and lenticellate-pustulate; inner bark whitish, turning red-brown on exposure, fibrous; sap creamy white to yellowish brown, gummy or sticky, *turning dirty brown on exposure*. **Sapwood** creamy white. Young twigs, petioles and veins on the lower leaf surface hispid with brown hairs 1–2 mm long. Terminal buds ovoid, often oblique. **Stipules** *paired*, somewhat interpetiolar, *linear to lanceolate*, 1–1.2 × 0.2 cm, hispid with brown hairs, caducous, scars distinct. **Leaves** membranous to thin-coriaceous, *appressed hairy to somewhat scabrid on both surfaces*; elliptic, subovate to obovate, (10–)12–15(–18) × 6–10 cm, base cordate to cuneate, often somewhat asymmetric, margin denticulate to subentire, apex acuminate; lateral veins 7–12 pairs, curving towards the leaf margin; intercostal venation reticulate, distinct beneath; petiole up to 1.5 cm long. **Inflorescences** borne on the new shoots together with new leaves, minutely appressed hairy. **Male inflorescences** discoid to reflexed pulvinate, 1–2 cm across; peduncle slender, *c.* 1.5 × 0.1 cm; involucral bracts linear, short. **Male flowers** up to 2 mm long; tepals spathulate. **Female inflorescences** 1-flowered, subsessile, with several small lanceolate bracts. **Female flowers:** *tepals minute*, lanceolate, free; styles soft-pubescent, stigmatic arms 1.3–1.7 cm long. **Fruits** borne on the twigs behind the leaves, ellipsoid to pyriform, 1.2–4.5 × 1–2 cm, *densely brown velutinous*, ripening red to crimson, purplish and finally black; peduncle short, less than 1 cm long; pulpy wall *c.* 1.5 mm thick; mesocarp fleshy; endocarp crustaceous, thin. **Seeds** 1–1.5 × 1 cm, smooth.

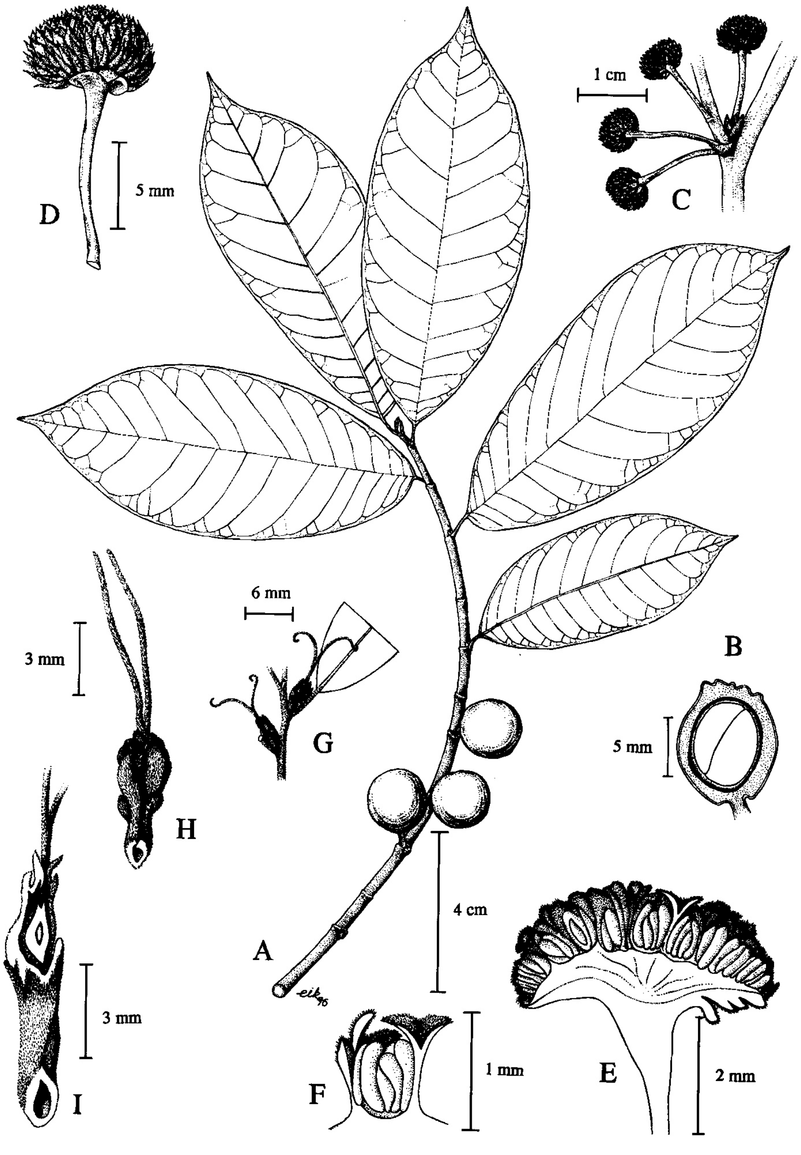

Fig. 1. *Antiaris toxicaria.* A, fruiting leafy twig; B, longitudinal section of fruit; C, axillary cluster of male inflorescences; D, male inflorescence; E, longitudinal section of male inflorescence; F, male flower; G, female inflorescences; H–I, female flowers. (A–B from *SAN 134550*, C–I from *SAN 42439*.)

Vernacular names. Sabah—*ipoh* (Malay). Sarawak—*ipoh* (Iban, Malay).

Distribution. As given under the genus. Of scattered occurrence in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. From lowland to lower montane forests up to 1500 m altitude, often near streams. Flowering in March to August; fruiting in May to December.

Uses. The poisonous components of the latex are cardiac glycosides (cardenolides), among which the antiarin in two forms is predominant (Bisset, Ann. Bog. 2 (1957) 219; Planta Medica 10 (1962) 143; Lloydia 29 (1966) 1 & 172). It arrests heart beat, like digitalin, but more potently. In Sarawak, the sap is tapped by making diagonal slashes on the bark, and is used by the aborigines to prepare arrow and dart poison. The untreated latex is used without alteration or after mixing it with sap of other plants, such as that of *Strychnos* species (Loganiaceae). The dart tips are dipped into the latex, turning the dart tips black. The poison remains virulent for many years. The bark can be made into bark cloth after thorough soaking in water to remove the poison. The trees yield a lightweight hardwood timber and sold under the trade name *terap*. It is locally used for light construction, interior finishing, furniture, moulding, panelling, flooring, and for making tool-handles. The timber is also suitable for manufacturing plywood, veneer and blockboard.

2. **ARTOCARPUS** J.R. & G. Forster, *nom. conserv.*

(Greek, *artos* = bread, *karpos* = fruit; the bread-fruit tree)

beruni (Dusun), *pudau*, *selangking* (Iban), *terap* (Malay)

K.M. Kochummen[†]

Char. Gen. (1786) 101; Blume, Bijdr. Fl. Ned. Ind. (1825) 479; Miquel, Fl. Ind. Bat. 1, 2 (1859) 284; King *in* Hooker *f.*, Fl. Br. Ind. 5 (1888) 539, Ann. Roy. Bot. Gard. Cal. 2 (1889) 1; Beccari, For. Born. (1902) 623; Merrill, En. Philip. Pl. 2 (1923) 40; Ridley, FMP 3 (1924) 351; Burkill, EPMP 1 (1935) 247; Browne, FTSB (1955) 349; Jarrett, J. Arn. Arb. 40 (1959) 113, *ibid.* 41 (1960) 73; Backer & Bakhuizen *f.*, FJ 2 (1965) 18; Burgess, TBS (1966) 399; Kochummen, TFM 3 (1978) 120; Anderson, CLTS (1980) 254; Wong, DMT (1982) 9; Primack, Forester's Guide to the Moraceae of Sarawak (1983) 16; Corner, WSTM 3rd. edition 2 (1988) 511; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 236; PROSEA 2 (1991) 79; Rohwer *in* Kubitzki *et al.* (eds.), Fam. & Gen. Vasc. Pl. (1993) 447; Kessler & Sidiyasa, Trees of Balikpapan-Samarinda Area, East Kalimantan (1994) 173; PROSEA 5, 2 (1995) 59; Coode *et al.* (eds.), CLBD (1996) 216; Argent *et al.* (eds.), MNDT-CK 2 (1997) 430.

Monoecious, small to medium-sized or large trees *with thick white latex in all living parts*, *without spines*; bole with or without buttresses. **Bark** without large lenticels, grey white, orange-brown or dark brown, smooth to fissured, scaly or dippled; inner bark yellowish brown. **Stipules** either *intrapetiolar*, *large*, *amplexicaul* (*clasping the twigs*) *and on falling leaving annular scars on the twigs* (subgen. *Artocarpus*), *or small*, *extrapetiolar*, *non-amplexicaul and on falling leaving lateral scars on the twig* (subgen. *Pseudojaca*). **Leaves** spirally arranged (subgen. *Artocarpus*) or distichous (subgen. *N 134550*, C–I from *SAN 42439*.) *Pseudojaca*), simple, entire or pinnately lobed or deeply pinnately incised, or compound-imparipinnate (*A. anisophyllus*). **Inflorescences** *unisexual*, *capitate*, with the heads cylindrical, club-shaped, ellipsoid or globose, short or long-peduncled or sessile, arising from the trunk and older branches or axillary; *males generally smaller than the females*; *involucral bracts absent*; interfloral bracts many, stalked, peltate, clavate or spathulate. **Flowers** numerous, compactly covering the surface of the receptacle; each perianth enclosing a single ovary or stamen, intermixed with interfloral bracts. **Male flowers** free; perianth tubular, entire or 2–4-lobed; *stamen 1*, exserted, anthers globose to oblong; pistillode absent. **Female flowers** at least distally connate with each other and/or with interfloral bracts; perianth well-developed and tubular (subgen. *Artocarpus*) or highly reduced or absent (subgen. *Pseudojaca*), lower part thin-walled, enclosing the ovary, upper part thick-walled with a narrow opening through which the style projects out, with the apices either completely fused to form an areolate or smooth surface or free and forming variously shaped processes on the surface of the female heads; ovary one-loculed, superior (subgen. *Artocarpus*) or inferior (subgen. *Pseudojaca*), style 1, apical to lateral, simple or bifid (the stigmatic arms equal or unequal), ovule subapical to lateral. **Syncarp** (multiple fruit) fleshy, formed by the enlargement of the entire female head (subgen. *Artocarpus*) or by the swelling of the receptacle of the female head (subgen. *Pseudojaca*), small to gigantic in size; in subgen. *Artocarpus*, at least the proximal parts of the perianth fleshy, and perianth of unfertilized ovaries elongate and become ribbon-like. **Fruits** drupaceous, not projecting from the syncarp surface. **Seeds** large; embryo straight or oblique, cotyledons equal or unequal; germination hypogeal, first two leaves opposite and fully developed or scale-like.

Distribution. About 55 species; native to the Indian subcontinent south of the Himalayas, Sri Lanka, Burma, Thailand, Indo-China, Southern China, Taiwan, Hainan, Malesia, and Melanesia. Twenty three (and one incompletely known) species are known in Sabah and Sarawak.

Ecology. Primary and secondary forests, mostly below 100 m, a few species occurring up to 2000 m altitude. Animals are the main seed dispersers. The fleshy perianth or the entire syncarp is eaten by arboreal mammals or birds. The very large fruit of *A. integer* arising from the stem is probably consumed by wild cattles, pigs and elephants. Some species with male heads emit a sweet scent of honey and burnt sugar which are insect-pollinated. Others have scentless male heads producing clouds of pollen at anthesis and hence appear to be wind-pollinated.

Uses. Species of *Artocarpus* produce light and medium hardwood. The light hardwood timber is known by the trade names *terap* (Peninsular Malaysia and Sabah) or *pudau* (Sarawak), while the medium hardwood timber is known as *keledang* (Peninsular Malaysia), *beruni* (Sabah), or *selangking* (Sarawak). In *terap*, the heartwood is yellow to pale brown and usually not differentiated from the sapwood; the wood is non-durable under tropical conditions. It is easy to work with, can be peeled satisfactorily and is suitable for plywood production. Locally, *terap* timber is used for light construction, for making boxes, crates, wooden pallets and veneer. The wood is sometimes nicely figured and therefore is suitable for decorative purposes like furniture, joinery and panelling. In *keledang*, the heartwood is orange to yellowish brown and well differentiated from the paler sapwood; the wood is non-durable to moderately durable, and is comparatively resistant to termite attack but susceptible to powder post beetle attack. It is difficult to saw, blunting saw tooth, probably due to the presence of tension wood or silica. *Keledang* timber is used for telegraph poles, wharves, large canoes, boat building, and light construction, or when under cover for house and bridge building, beams, poles, flooring, furniture, joinery, cabinet work, household utensils, musical instruments, turnery, veneer and plywood. It is favoured as hewn coffin among the Chinese. The roots of old *Artocarpus heterophyllus* are highly prized for carving and picture framing. Many species produce fruits which are edible. Examples are *A. altilis*, the breadfruit, *A. heterophyllus*, the Jackfruit and *A. integer*, the *chempedak*, with the former two species are widely cultivated throughout the tropics. *A. odoratissimus* is widely cultivated in Sabah and Sarawak for its edible fruits. Seeds are eaten after roasting. The bark of some species is used for cordage and formerly widely utilized by the aborigines to make loin cloths and jackets. The latex, bark, leaves and roots of some species have medicinal properties, and the latex is used as bird-lime and when mixed with wax is used in batik printing. Large leaves of a few species such as *A. elasticus* and *A. odoratissimus* are used as thatch, to make partitions in long houses, and for temporary field huts.

Key to *Artocarpus* species

1. Leaves compound-imparipinnate; leaflets of unequal sizes...……………..….**1. A. anisophyllus**
   Leaves simple, entire, lobed, faintly toothed towards apex, shallowly crenate, or deeply pinnately incised down to the midrib with equal segments..………………....……..……..….2

2. Leaves of adult and juvenile trees deeply, pinnately lobed or incised down to the midrib………………………………………………………...…..…...........……………..

   A. altilis (Parkinson) Fosberg
   (Latin, *altus* = tall; the tree)
   J. Acad. Sci. Wash. 31 (1941) 95. Synonyms: *A. communis* J.R. & G. Forst., Char. Gen. (1776) 101; *A. incisus* Linn. *f.*, Suppl. Pl. (1781) 411.
   Pulon, *kukor*, *sukun*, (breadfruit). Native of New Guinea and Micronesia; cultivated throughout the tropics for the edible fruits.

   Leaves of adult trees entire, lobed, faintly toothed towards apex, or shallowly crenate; those of juvenile trees entire, or lobed, or deeply pinnately incised…...…..………………………..3

3. Lateral veins sunken above………......…..……………………………….………………...4
   Lateral veins raised or flat above.......…………...……………….…………….……………...8

4. Leaf margin lobed.......……………………………………….….………….....…………..…5
   Leaf margin entire, plane or faintly toothed towards apex…..……………….….………………6

5. Twig and petiole densely hispid-pubescent with tawny subpatent hairs 4–7 mm long. Leaves 18–25 cm broad; petiole 1–2 cm long......………………………………..**20. A. sarawakensis**
   Twig and petiole sparsely pubescent with patent reddish brown hairs up to 5 mm long. Leaves 11–18 cm broad; petiole 3.5–4.5 cm long.......………………………...**21. A. tamaran**

6. Petiole up to 0.7 cm long. Leaves soft-hairy below..........…..……………..….…...**12. A. longifolius**
   Petiole at least 1 cm long. Leaves rough-hairy below......…………………………….……………...7

7. Petiole 2–5.5 cm long. Lower leaf surface often glaucous; leaf margin plane. Syncarp warty..………………………………………………………......…**18. A. primackiana**
   Petiole 1–3 cm long. Lower leaf surface not glaucous; leaf margin faintly toothed towards apex. Syncarp densely covered with sharp rigid processes……………........…………………
   ……………………………………….................…………...……**19. A. rigidus** (in part)

8. Leaves often glaucous below; midrib sunken above……………………………………**7. A. glaucus**
Leaves not glaucous below; midrib raised or flat above……………………………………9

9. Leaf apex cuspidate or rounded……………………………………………………10
Leaf apex acute, acuminate, or obtuse……………………………………………………11

10. Leaf apex cuspidate; intercostal venation scalariform (ladder-like)……………**2. A. annulatus**
Leaf apex rounded, intercostal venation reticulate (net-like)……………………**15. A. obtusus**

11. Leaves glabrous (to unaided eye) on both surfaces or sparsely pubescent only on the veins below……………………………………………………………………12
Leaves sparsely or densely hairy all over at least on the lower surface……………………18

12. Leaf margin lobed, undulate, or shallowly crenate……………………………………13
Leaf margin entire and plane……………………………………………………15

13. Leaves thick-coriaceous, drying grey-green……………………………**11. A. lanceifolius**
Leaves thin-coriaceous, drying reddish brown…………………………………………14

14. Leaves scabrid (sandpapery to the touch) above; petiole 3–5 cm long; lateral veins 12–15 pairs……………………………………………………………**3. A. corneri**
Leaves glabrous or nearly so above; petiole 1–3.5 cm long; lateral veins 6–12 pairs……………………………………………………………**22. A. teysmannii**

15. Lateral veins and intercostal venation distinctly visible above……………**14. A. nitidus** (in part)
Lateral veins and intercostal venation invisible or very faintly visible above……………16

16. Lateral veins 12–20 pairs……………………………………………………**6. A. excelsus**
Lateral veins 9–13 pairs……………………………………………………………17

17. Syncarp *c.* 4.5 × 3.5 cm, borne on twigs behind the leaves, surface areolate ……………………………………………………………**10. A. kemando** (in part)
Syncarp 30–100 cm long, borne on stem and older branches, surface short-spiny……………
A. heterophyllus Lamarck
(Greek, *heteros* = different, *phullon* = leaves; with different types of leaves)
Encycl. Meth. 3 (1789) 210.
Nangka, Jackfruit. Possibly indigenous to S India. Cultivated throughout the tropics for the edible fruits.

18. Leaves sparsely hairy below……………………………………………………19
Leaves densely hairy below……………………………………………………21

19. Hairs of midrib and lateral veins on lower leaf surface long and wavy. Inflorescences and syncarps arising from trunk and older branches……………………**8. A. integer**
Hairs of midrib and lateral veins on lower leaf surface short and appressed. Inflorescences and syncarps axillary or on twigs behind the leaves……………………………………20

20. Lateral veins and intercostal venation distinctly visible above………...**14. A. nitidus** (in part)
    Lateral veins and intercostal venation faintly visible above...............**10. A. kemando** (in part)

21. Leaves soft-hairy below......……………......………………………………….……………22
    Leaves rough-hairy below......……………………....……………………………………...…24

22. Indumentum yellowish. Syncarp with peduncle up to 3 cm long....………………....**4. A. dadah**
    Indumentum reddish brown. Syncarp with peduncle (3–)4–5(–7) cm long....………….…...23

23. Twig up to 3 mm thick. Syncarp irregularly lobed.......…………….……**23. A. tomentosulus**
    Twig 3–8 mm thick. Syncarp smooth.......……………….……………….……**17. A. peltatus**

24. Leaves 10–35 cm broad......……………………………......…………………….………25
    Leaves usually less than 10 cm broad.......…………………....……………………….…26

25. Petiole 4–10 cm long. Syncarp cylindrical, covered with fleshy hispid processes of different sizes......……………………………………...……………………………**5. A. elasticus**
    Petiole 1–3 cm long. Syncarp subglobose, covered with rigid cylindrical processes of similar size.......………………………………...……………………….....**16. A. odoratissimus**

26. Petiole 3–5 cm long.......…………………………..…….……………...….**9. A. jarrettiae**
    Petiole up to 3 cm long..........…………………...…………………………..…………...27

27. Leaf margin faintly toothed towards apex. Syncarp densely covered with sharp, rigid processes........…………….………………...……………………....**19. A. rigidus** (in part)
    Leaf margin entire. Syncarp almost smooth………..……………………..**13. A. melinoxylus**

1. **Artocarpus anisophyllus** Miq. Fig. 2.
(Greek, *aniso-* = unequal, *phullon* = leaves; the unequally sized leaflets)

Fl. Ind. Bat., Suppl. (1861) 422; Merrill, PEB (1929) 45; Masamune, EPB (1942) 238; Brown *l.c.* 352; Jarrett *l.c.* (1959) 138; Burgess *l.c.* 399; Kochummen *l.c.* 123; Anderson *l.c.* 254; Primack *l.c.* 26; Corner *l.c.* (1988) 515; Whitmore, Tantra & Sutisna *l.c.* 236; Kessler & Sidiyasa *l.c.* 174; PROSEA *l.c.* (1995) 64; Turner, Gard. Bull. Sing. 47 (1995) 347; Coode *et al*. (eds.) *l.c.* 210; Argent *et al.* (eds.) *l.c.* 432. **Type:** *Teijsmann HB 3698*, Sumatra, Palembang, Batu Raja (holotype U; isotypes BO, K, L). **Synonyms:** *A. klidang* Boerl., Handl. Fl. Ned. Ind. 3 (1900) 333; *A. superba* Becc. *l.c.* 625, Merrill *l.c.* (1921) 219, Ridley *l.c.* (1924) 356.

Tree up to 45 m tall, 90 cm diameter; buttresses spreading, up to 2.5 m tall. **Bark** dark grey, smooth to dippled; inner bark yellowish brown. **Twigs** stout, *c*. 1 cm thick, smooth or irregularly ridged, set with ring-like stipular scars. **Stipules** *amplexicaul*, 4–17 cm long, appressed pubescent. **Leaves** *spirally arranged*, *compound-imparipinnate*, rachis up to 90 cm long. *Leaflets* oblong, ovate or lanceolate, 3.5–40 × 2–13 cm, subopposite, *unequal in size, smaller ones alternating with larger ones*, terminal leaflets almost always bifid; midrib raised above; *lateral veins* 7–20 pairs, *sunken above*, raised below; *venation scalariform*, faint to distinct below, faint above. **Inflorescences** axillary, males and females usually paired; bracts slenderly stalked, apical parts funnel-shaped; peduncle 5–6.5 cm long. **Male heads** ellipsoid-oblong, 3–7.5 × 1.5–2 cm; perianth tubular, *c*. 1.8 mm long, shortly bilobed, minutely hairy; stamens 2–2.5 mm long, filament slender, cylindrical, anthers subglobose, *c*. 0.2 mm long. **Syncarps** subglobose, up to 11 × 8 cm, covered with cylindrical, rigid, minutely punctate, obtuse processes (perianth-apices) 6–8 × 1–1.5 mm; pulp (fleshy perianth) orange; peduncle 6–13 cm long. **Seeds** ellipsoid, *c*. 1.7 × 1 cm.

Vernacular names. Sabah—*terap ikal* (Dusun, preferred name). Sarawak—*bintau* (Bidayuh, Sadong), *bintawak* (Bidayuh, Iban), *denging* (Kayan), *entawa*, *mentawa* (Iban), *kayo bakek* (Kayan), *kayo bibungan* (Berawan), *kelidang* (Murut), *tawak* (Kenyah, Punan Tutoh).

Distribution. Sumatra, Peninsular Malaysia and Borneo. Widely distributed in Sabah, uncommon in Sarawak. The typical variety also occurs in Brunei and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, up to 600 m altitude.

Uses. In Sarawak, the timber is traded under the name *bintawak* and locally used for indoor constructions and for making household utensils and tool-handles. The fruits are edible.

Key to varieties

Twig ridged. Leaflets distinctly stalked.......……………....……………………var. **anisophyllus**
Twig smooth. Leaflets sessile.......…………………….....……...……………..…………………

var. **sessilifolius** Kochummen
(Latin, *sessile* = stalkless, *folium* = leaf)

Gard. Bull. Sing. 50 (1998) 200. Type: *Wood SAN 16549*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype SAN; isotypes A, BO, K, KEP, L, SING).

Endemic to Borneo. Widely distributed in Sabah, but in Sarawak known only by a single collection, *Hewitt 177*, from Kuching district. Not known in Brunei and Kalimantan.

2. **Artocarpus annulatus** Jarrett

(Latin, *annulatus* = marked with rings; the ring-like constrictions on male inflorescences)

Blumea 22 (1975) 409; Anderson *l.c.* 254; Whitmore, Tantra & Sutisna *l.c.* 236; Primack *l.c.* 26. **Type:** *Chew & Anderson CWL 665*, Borneo, Sarawak, Kuching district, Mt. Mentawa (holotype K; isotypes L, SAR).

Tree up to 10 m tall, 20 cm diameter. **Twigs** brown, 3–5 mm thick, sparsely pubescent with subrecurved, apically barbed hairs, or glabrous. **Stipules** *amplexicaul*, *c*. 4 cm long, sparsely hairy. **Leaves** *simple*, *spirally arranged*, both surfaces glabrous or the midrib and veins hairy above; broadly elliptic or obovate, 10–30 × 5–16.5 cm, base cuneate, *margin entire*, *plane*, *apex cuspidate*; *midrib raised above*; *lateral veins* 4–7 pairs, *raised on both surfaces*, distinctly curving along the leaf margin; *intercostal venation scalariform*,

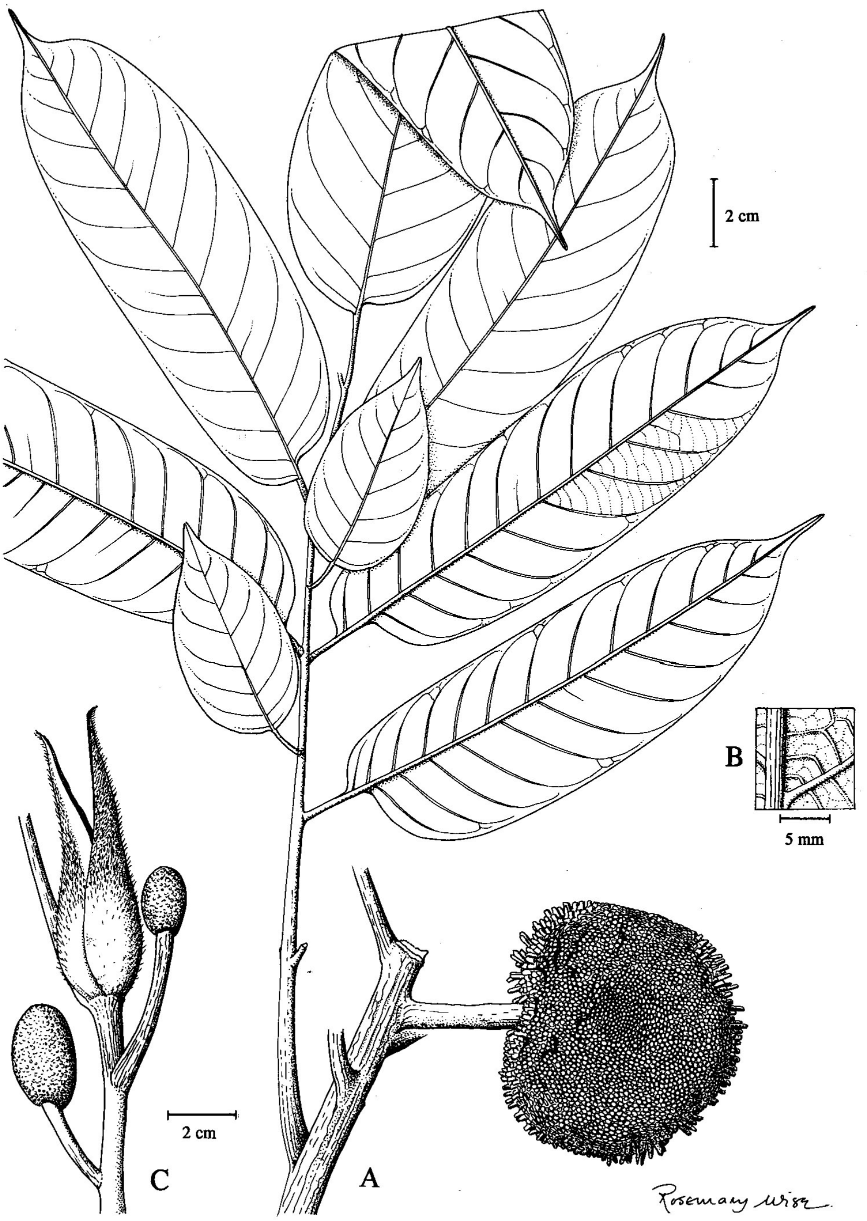

Fig. 2. *Artocarpus anisophyllus*. A, leafy twig with a syncarp (multiple fruit); B, detail of lower surface of leaflet; C, young shoot with male inflorescences and stipules. (A–B from *Chai S. 31726*, C from *Wood SAN 15198*.)

distinct below, faint above; petiole 2.5–5 cm long. **Inflorescences** solitary, axillary or borne on the stem; peduncle 1.5–2.5 cm long, hairy; interfloral bracts with stout stalks and peltate apical parts. **Male heads** ovoid, *c.* 3.5 × 3.5 cm, *surface wrinkled by ring-like constrictions*; perianth deeply 2(–4)-lobed, *c.* 0.8 mm long; stamens one or two, filaments sometimes basally connate, *c.* 1 mm long, anthers ellipsoid, *c.* 0.1 mm long. **Female heads** with simple, exserted, filiform styles. **Syncarps** ellipsoid, *c.* 8 × 6 cm, covered with fleshy, cylindrical, obtuse, short-hairy processes intermixed with numerous intrafloral bracts; stalks of the bracts thread-like and the apices funnel-shaped; peduncle up to 3 cm long.

Vernacular names. Sarawak—*bukoh* (Iban), *patat* (Bidayuh).

Distribution. Endemic to Borneo; very rare, known only from Mt. Mentawa near Kuching in Sarawak.

Ecology. In forest on limestone hills, at 150–300 m altitude.

3. **Artocarpus corneri** Kochummen Fig. 3.

(E.J.H. Corner, 1906–1996, formerly prominent Professor of Tropical Botany, University of Cambridge, U.K., who undertook extensive studies of the Malesian Moraceae)

Gard. Bull. Sing. 50 (1998) 187. **Type:** *Dayang Awa & Yii S. 46878*, Borneo, Sarawak, Dulit Range, Belaga (holotype KEP; isotypes CGE, K, L, SAN, SAR).

Tree up to 22 m tall, 50 cm diameter. **Twigs** 7–9 mm thick, dark brown, closely ridged, very sparsely short-hairy, with distinct ring-like stipular scars. **Stipules** *amplexicaul*, lanceolate, up to 3 cm long, densely covered with long hairs. **Leaves** *simple*, *spirally arranged*, *thin-coriaceous*, *upper surface scabrid*, *lower surface glabrous to unaided eye but with short rough hairs on the midrib and lateral veins*, *drying reddish brown* to chocolate-brown; obovate or oblong, (12–)17–28 × (5.5–)7–12 cm, base cuneate, *margin faintly lobed*, *apex acuminate or acute*; *midrib raised above*; *lateral veins 12–15 pairs*, raised below, *flat above*; intercostal venation scalariform, faintly visible below, invisible above; *petiole 3–5 cm long*, sparsely pubescent with short hairs. **Inflorescences** and **flowers** unknown. **Syncarps** (immature) axillary, solitary, cylindrical, 5–7 × 3.5–4 cm; peduncle 5.5–8 cm long; perianth densely hairy, styles distinctly bifid.

Distribution. Endemic to Borneo; known only by two collections, *S. 38879* from the Maligan Range, Lawas district and the type, from Belaga district, in Sarawak.

Ecology. In hill mixed dipterocarp forest, at 800–1000 m altitude.

4. **Artocarpus dadah** Miq.

(after the vernacular name *dadah* from Lampong, Sumatra)

Fl. Ind. Bat., Suppl. (1861) 420; Corner, Gard. Bull. Str. Settl. 10 (1939) 282, *l.c.* (1988) 516; Browne *l.c.* 352; Jarrett *l.c.* (1960) 91; Kochummen *l.c.* 124; Anderson *l.c.* 254; Primack *l.c.* 28; Whitmore, Tantra & Sutisna *l.c.* 236; PROSEA *l.c.* 347; Coode *et al.* eds.) *l.c.* 210; Argent *et al.* (eds.)*l.c. 432.* **Type:** ***Teijsmann HB 4391,*** Sumatra (holotype U; isotypes BO, K, L**). Synonyms:** *A. mollis* Miq. *l.c.* (1861) 420; *A. rufescens* Miq. *l.c.* (1861) 420; *A. tampang* Miq. *l.c.* (1861) 421; *Ficus tampang* (Miq.) Miq. *l.c.*

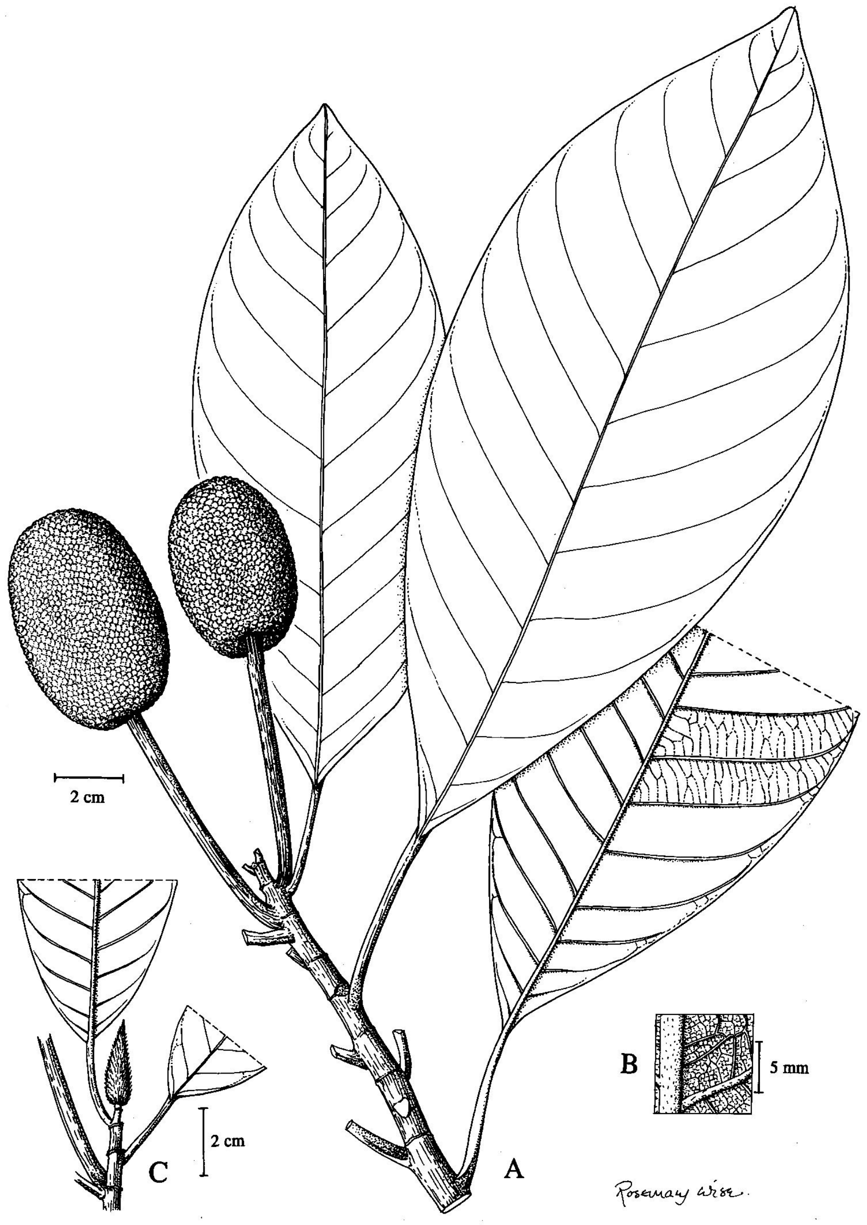

Fig. 3. *Artocarpus corneri.* A, leafy twig with two young syncarps; B, detail of lower leaf surface; C, young shoot with hairy stipules. (A–B from *Ilias S. 32879,* C from *Dayang Awa & Yii S. 46878.*)

(1861) 425; *Ficus inconstatissima* Miq. *l.c.* (1861) 431; *A. inconstantissima* (Miq.) Miq., Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 211; *A. dadah* Miq. Var. *pubescens* Miq. L.c. (1867) 213; *A. lakoocha* Roxb. var. *malayana* King in Hooker *f.*, Fl. Brit. Ind. 5 (1888) 544; *A. reniformis* Becc. *l.c.* 631; *A. dasyphylla auct., non* Miq.: Merr PEB (1929) 46.

Deciduous tree up to 35 m tall, 60 cm diameter. **Bark** grey-brown, distanly fissured. **Twigs** 2.5-5 mm thick, *densely pubescent with short yellowish to reddish brown hairs.* **Stipules** *non-amplexicaul.* **Leaves** *simple, distichous,* upper surface glabrous except for the sparse short hairs on the midrib and lateral veins, *lower surface densely pubescent with yellowish to reddish brown soft hairs;* obovate-oblong, elliptic-oblong, or ovate-elliptic, 10-25 (-30) x 5-11 cm, base rounded to broadly cuneate or shallowly cordate, *margin entire, plane, apex obtuse or acute; midrib raised above; lateral veins* 12-20 pairs, looping near the leaf margin, raised below, flat above; intercostals venation scalariform or reticulate, distinct below, faint above; petiole 0.5-2 cm long, hairy. *Leaves of juvenile trees pinnately lobed.* **Inflorescences** solitary, axillary, bracts stoutly stalked, their apical parts narrowly peltate; peduncle 0.8-3 cm long, yellowish hairy. **Male heads** *globose,* 0.8-1.5 cm across; perianth 2-3-lobed, c. 0.3 mm long, stamens c. 0.5 mm long. **Female heads** with similar bracts; female flowers with exserted styles. **Syncarps** subglobose or obovoid, 5-7 cm across, green with deep pink flesh, surface smooth; *peduncle up to 3 cm long.*

Vernacular names. Sabah-*beruni* (Dusun, preferred name). Sarawak-*dadah* (Iban, Malay), *dadak, merubi, selangking* (Iban).

Distribution. Burma, Thailand, Sumatra, Peninsular Malaysia, and Borneo. Common in Sabah; rare in Sarawak, known by one collection each from the 1st and 7th Divisions. Also in Brunei and Kalimantan.

Ecology. In lowland forest on hilly sites, up to 300 m altitude.

Uses. *A. dadah* is fairly important source of *beruni* and *selangking* timber, and the wood is used for house poles and flooring. The latex is reported to have disinfectant property and is applied on wounds. The fruit is edible but sour.

5. **Artocarpus elasticus** Reinw. *ex* Blume

(Latin, *elasticus*=elastic; the latex)

Bijdr. FI. Ned. Ind. (1825) 481; Merrill *l.c.* (1921) 218; Burkill, EPMP (1935) 251; Masamune *l.c.* 234; Jarret *l.c.* (1959) 346; Backer & Bakhuizen f. *l.c.* 18 Browne *l.c.* 403; Kochummen *l.c.* 237; Ardeson *l.c.* 254; Primack *l.c.* 29; Corner *l.c.* (1988) 516; Whitmore, Tantra & Sutisna *l.c.*237; PROSEA *l.c.* (1995) 65; Turner *l.c.* 347; Coode *et al.* (eds) *l.c.* 210: Argent *et al.* (eds) *l.c* 433. **Type:** *Reinwardt s.n.* (*=RHL Sheet No. 9081851027*), Java (holotype L). **Synonyms:** *A. blumei* Trec., Ann. Sci. Nat. Bot. 3, 8 (1847) 111, Merrill *l.c* (1921) 218, Masamune *l.c* 238; *A. kunstleri* King *in* Hooker *f.*, F1. Brit. Ind. 5 (1880) 540, Riddley *l.c* (1924) 353; *A. blumei* Trec.var. *kunstleri* Boerl., Handl. F1. Ned. Ind. 3 (1900) 370; *A. pubescens auct., non* Willd.: Blume *l.c* (1825) 481; *A. sericarpus* Jarrett *l.c.* (1959) 350, Anderson *l.c.* 256.

Tree up to 45 m tall, 90 cm diameter, with prominent buttresses up to 3 m tall. **Bark** grey-brown, smooth to slightly scaly; inner bark pale brown. **Twigs** 10–20 mm thick, rough-hairy. **Stipules** *amplexicaul,* 6–20 cm long, hispid-pubescent with yellowish or reddish brown, patent or appressed hairs. **Leaves** *simple, spirally arranged, upper surface sparsely rough-hairy, lower surface densely rough-hairy*; ovate or elliptic to oblong, *15–60 × 10–35 cm*, base usually rounded, rarely cuneate, *margin entire, plane or shallowly crenate, apex acute*; *midrib raised above*; lateral veins 12–14 pairs, prominently raised below, *flat and distinct above*; intercostal venation scalariform or reticulate, prominent below, faint above; *petiole 4–10 cm long*. *Leaves of juvenile trees 2–3-times pinnatifid, up to 200 cm long*. **Inflorescences** solitary, axillary; peduncle 4–7.5 cm long, hairy. **Male heads** cylindrical, 6–15 cm long, *with distinct deep grooves*; perianth bilobed, *c*. 0.8 mm long, appressed pubescent, stamens *c*. 0.9 mm long, anthers oblong, *c*. 0.4 m long. **Female heads** with simple or bifid, exserted styles. **Syncarps** *cylindrical*, up to 12 × 6 cm, yellow-brown, *covered by fleshy, whitish, short-hispid processes of two lengths,* the longer flexuous and slightly tapering, solid, 10–18 × 1–1.5 mm, and the shorter ones narrowly conical, perforate, *c*. 4 × 1 mm; bracts with funnel-shaped upper parts, scattered; peduncle 6.5–12 cm long, hairy.

Vernacular names. Sabah—*terap togop* (Dusun, preferred name). Sarawak—*kian* (Berawan, Kayan, Kenyah), *pedalai*, *tekalong* (Iban), *pien* (Bidayuh), *terap* (Malay, preferred name), *tian* (Bidayuh, Sadong).

Distribution. Burma, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Maluku, and Lesser Sunda Islands. Common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary and secondary lowland to lower montane forests, up to 1500 m altitude.

Uses. The fleshy fruiting perianth is edible, and the seeds are also eaten after roasting. The bark is used by the aborigines in Sarawak as cordage for making ropes and cloths. The latex is used for preparing bird-lime. The timber is known and sold as *terap* and is used mainly for light construction.

6. **Artocarpus excelsus** Jarrett
(Latin, *excelsus* = lofty, high; the tree)

Blumea 22 (1975) 409; Coode *et al*. (eds.) *l.c.* 210. **Type:** *Chew & Corner RSNB 7046*, Borneo, Sabah, Mt. Kinabalu, Mesilau R. (holotype K; isotypes L, SING).

Tree up to 35 m tall, 50 cm diameter, buttresses sometimes present. **Bark** grey, scaly. **Twigs** *c*. 5 mm thick, dark brown, rugose. **Stipules** *amplexicaul*, appressed hairy, oblong, up to 5.5 cm long. **Leaves** *simple, spirally arranged*, upper surface glabrous, *lower surface appressed hairy on the midrib and veins only*; narrowly oblong or elliptic, 10–22 × 2–6.5 cm, base cuneate, *margin entire, plane, apex acute*; *midrib black on drying, flat above*; *lateral veins 12–20 pairs, flat and faintly visible above*, raised below; *intercostal venation reticulate, visible below only*; petiole 1.5–3 cm long. *Juvenile leaves shallowly irregularly pinnatifid*. **Male heads** cylindrical, 1.7–2.2 × 0.5 cm; perianth bilobed, *c*. 0.8 mm long, stamens *c*. 1 mm long, filaments slender, cylindrical, anthers ellipsoid, *c*. 0.2 mm long. **Female heads** with simple exserted styles. **Syncarps** irregularly cylindrical, *c*. 7 × 4 cm, dull ochre-yellow, covered by fleshy, conical blunt processes projecting up to *c*. 1 mm high and 1.5 mm broad; fruiting perianth numerous, proximal free parts thinly fleshy, whitish; peduncle 1–2.5 cm long, appressed hairy.

Disribution. Endemic to Borneo. Recorded only for Mt. Kinabalu where it is common, and from G. Pagon Periok in Brunei–Sarawak border.

Ecology. In lower montane forest, at 1400–1800 m altitude.

7. **Artocarpus glaucus** Blume

(Latin, *glaucus* = sea-green; the colour of the leaf undersurface)

Bijdr. Fl. Ned. Ind. (1825) 483; Browne *l.c.* 353; Jarrett *l.c.* (1960) 118; Backer & Bakhuizen *f. l.c.* 19; Kochummen *l.c.* 126; Anderson *l.c.* 254; Primack *l.c.* 30; Whitmore, Tantra & Sutisna *l.c.* 237; PROSEA *l.c.* (1995) 66; Turner *l.c.* 347; Coode *et al.* (eds.) *l.c.* 210; Argent *et al.* (eds.) *l.c.* 433. **Type:** *Blume s.n.* (= *RHL Sheet No. 908185719*), Java (holotype L). **Synonyms:** *A. glaucescens* Tréc., Ann. Sc. Nat. Bot. 3, 8 (1847) 120; *A. zollingeriana* Miq. *in* Zollinger, Syst. Verz. 2 (1854) 90 & 95; *A. biformis* Miq., Fl. Ind. Bat., Suppl. (1861) 419; *A. tephrophylla* Miq. *l.c.* (1861) 422; *A. glaucescens* Tréc. var. *tephrophylla* Miq., Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 212; *A. denisoniana* King *in* Hooker *f.*, Fl. Brit. Ind. 5 (1888) 544, Ridley *l.c.* (1924) 355.

Tree up to 40 m tall, 80 cm diameter, with or without buttresses. **Bark** reddish or greyish brown, smooth or somewhat fissured, flaky; inner bark fibrous, yellowish; sap yellowish white. **Twigs** slender, 1.5–4 mm thick, finely rugose, appressed hairy, early glabrescent. **Stipules** *non-amplexicaul*. **Leaves** *simple, distichous*, upper surface glabrous, *lower surface glaucous* and appressed hairy; elliptic-oblong, obovate, or ovate-lanceolate, 6–20 × 3–8 cm, base asymmetric, broadly cuneate, *margin entire*, *plane*, *apex acute*; *midrib sunken above*; *lateral veins* 8–15 pairs, raised below, *flat above*; intercostal venation scalariform or reticulate, distinct below, flat above; petiole 0.7–4.5 cm long. **Inflorescences** solitary or paired, axillary; bracts with peltate upper parts; peduncle up to 0.3 cm long. **Male heads** oblong or club-shaped; perianth 2–3-lobed, divided almost to the base. **Female flowers** with exserted styles. **Syncarps** knobbly, subglobose, up to 3 cm across, yellow to orange-brown with light orange flesh, surface papillate or smooth, short-pubescent; peduncle 0.2–0.5 cm long, velvety hairy.

Vernacular names. Sarawak—*merubi* (Malay Baram), *pudau putih* (preferred name), *selangking* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Java, Lesser Sunda Islands, and Borneo. Uncommon in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland to hill forests, up to 1000 m altitude.

Use. The timber is classified as *terap*, and is used for house-building.

8. **Artocarpus integer** (Thunb.) Merr.
(Latin, *integer* = entire; the leaf margin)

Interpr. Rump. Herb. Amb. (1917) 190; Merrill *l.c.* (1921) 219 (*integra*); Ridley *l.c.* (1924) 354; Corner, Gard. Bull. Str. Settl. 10 (1939) 56, *l.c.* (1988) 518; Masamune *l.c.* 234 (*integra*); Jarrett *l.c.* (1959) 329; Backer & Bakhuizen *f. l.c.* 19; Burgess *l.c.* 399; Kochummen *l.c.* 127; Anderson *l.c.* 255; Primack *l.c.* 32; Whitmore, Tantra & Sutisna *l.c.* 237; PROSEA 2 (1991) 91; Turner *l.c.* 347; Coode *et al*. (eds.) *l.c.* 211; Argent *et al.* (eds.) *l.c.* 434. **Basionym:** *Radermachia integra* Thunb., Vet. Akad. Handl. Stockholm 37 (1776) 254. **Type:** *Thunberg s.n.*, Java (holotype UPS; isotype L). **Synonyms:** *A. jaca* Lam., Encycl. 3 (1789) 209; *Polyphema champeden* Lour., Fl. Cochinch. (1790) 546, *p.p.*; *A. champeden* (Lour.) Stokes, Bot. Mat. Med. 4 (1812) 330; *A. hirsutissima* Kurz, Natuurk. Tijdschr. Ned. Ind. 27 (1864) 182.

Tree up to 24 m tall, 60 cm diameter; bole without buttresses, with bumps where syncarps are produced. **Bark** dark grey-green, dippled to somewhat scaly; inner bark yellowish. **Twigs** 2.5–4 mm thick, smooth or shallowly rugose, sparsely to densely pubescent with patent, rufous hairs up to 3 mm long. **Stipules** *amplexicaul*, ovate, acute, 1.5–9 cm long, hairy. **Leaves** *simple*, *spirally arranged*, upper surface glabrous except for the sparsely hairy midrib and lateral veins, *lower surface often sparsely appressed pubescent with reddish brown*, *long*, *wavy hairs*; elliptic to oblong or obovate, 5–25 × 2.5–12 cm, base cuneate or rounded, *margin entire*, *plane*, *apex acute*; *midrib raised above*; *lateral veins* 6–10 pairs, *flat above*, distinct below; intercostal venation scalariform, faint; petiole 0.8–3 cm long, hairy. **Inflorescences** solitary, axillary or *borne on short leafy shoots on older branches or from the bumps on the main trunk*; peduncle 2.5–6 cm long, hairy. **Male heads** cylindrical to club-shaped, 3–5.5 × 1–1.2 cm; perianth 0.7–1 mm long, shortly bilobed, stamens 1–1.3 mm long, anthers ellipsoid, *c*. 0.3 mm long. **Female flowers** with simple thread-like styles exserted to *c*. 1.5 mm long. **Syncarps** *arising from trunk and older branches*, cylindrical or oblong, 20–35 × 10–15 cm, yellow to yellowish green with strong penetrating odour when ripe; surface covered by firm, obtuse, minutely hispid processes 2–4 × 3 mm, fleshy perianth surrounding fruit yellow, shinning, sweet; peduncle 5.5–6.5(–12) cm long, hairy.

Vernacular names. Sabah—*pulutan* (Dusun, preferred name). Sarawak—*beluno* (Murut), *bukoh*, *temedak* (Iban), *chempedak* (Malay, preferred name), *nakan* (Berawan, Kayan, Kenyah, Punan), *tibadak* (Bidayuh, Sadong), *tibudak* (Bidayuh).

Distribution. Thailand, Peninsular Malaysia, Sumatra, Borneo, Sulawesi, Maluku, and New Guinea. Common in Sabah and Sarawak. Also in Brunei and Kalimantan. Two varieties, viz. var. *integer* and var. *sylvestris*, are recognised. Only the former occurs in Sabah and Sarawak.

Ecology. In primary and secondary lowland forests, up to 500 m altitude.

Uses. Planted extensively for the edible fruits. The young fruits are cooked as vegetable, while the ripe fruits are consumed fresh or coated with flour and deep-fried. Seeds are eaten after boiling or roasting.

9. **Artocarpus jarrettiae** Kochummen
(J. Francis Jarrett, former botanist at the Royal Botanic Gardens, Kew, U.K., who revised the genus *Artocarpus* for the Malesian region)

Gard. Bull. Sing. 50 (1998) 198. **Type:** *Amin & Francis SAN 120933*, Borneo, Sabah, Ranau district (holotype SAN; isotypes K, KEP, L).

Tree up to 15 m tall, 30 cm diameter. **Twigs** 6–7 mm thick, dark brown, closely ridged. **Stipules** *amplexicaul*, lanceolate, up to 5.5 cm long, with recurved edges, densely long-hairy outside. **Leaves** *simple*, *spirally arranged*, *upper surface sparsely rough-hairy*, *lower surface densely rough-hairy*; elliptic or oblong, *16.5–23 × 8.5–10(–12) cm*, base cuneate, *margin entire*, *plane*, *apex obtuse or acute*; *midrib raised above*; *lateral veins* 11–13 pairs, raised below, *flat above*; intercostal venation scalariform, visible below, faint above; *petiole 3–5 cm long*, short-hairy. **Inflorescences** not seen. **Syncarps** (immature) solitary, axillary, yellowish green when fresh, *cylindrical*, *c.* 4.5 × 3 cm; perianth of female flowers covered with glandular hairs with swollen bases, style exserted, simple; peduncle 4.5–5.5 cm long, rough-hairy.

Distribution. Endemic to Borneo; very rare, known only by one collection each from Sabah (the type) and Sarawak, *S. 54906*, from Sarikei district.

Ecology. In lowland forest by streams.

10. **Artocarpus kemando** Miq.

(from the Sumatran vernacular name—*kemando*)

Fl. Ind. Bat., Suppl. (1861) 418; Beccari *l.c.* 628; Merrill *l.c.* (1921) 219, *l.c.* (1929) 46; Ridley FMP 5 (1925) 335; Burkill *l.c.* 256; Corner *l.c.* (1939) 282, *l.c.* (1988) 519; Masamune *l.c.* 240; Jarrett *l.c.* (1959) 354; Kochummen *l.c.* 129; Anderson *l.c.* 255; Primack *l.c.* 33; Whitmore, Tantra & Sutisna *l.c.* 237; PROSEA *l.c.* (1995) 67; Turner *l.c.* 347; Coode *et al.* (eds.) *l.c.* 211; Argent *et al.* (eds.) *l.c.* 434. **Type:** *Teijsmann HB 4515*, Sumatra, Lampong, Kebong (holotype U; isotypes BO, L). **Synonym:** *A. brunneifolia* S. Moore, J. Bot. 63 (1925) Suppl. 112.

Tree up to 35 m tall, 80 cm diameter, with spreading buttresses up to 2.5 m tall. **Bark** grey, smooth; inner bark white to reddish. **Twigs** 2–2.5 mm thick, finely pubescent with appressed reddish hairs. **Stipules** *amplexicaul*, lanceolate, acute, 0.7–2 cm long, appressed pubescent with reddish hairs. **Leaves** *simple*, *spirally arranged*, *upper surface glabrous*, *lower surface glabrous or sparsely appressed short-hairy on the midrib and lateral veins*; elliptic to oblong, 5–21 × 2–9 cm, base rounded or cuneate, *margin entire*, *plane*, *apex acute or obtuse*; *midrib flat above*; *lateral veins 9–13 pairs*, looping near the leaf margin, distinct below, *flat or faintly visible above*; intercostal venation scalariform or reticulate, visible below, *faintly visible above*; petiole 1–2 cm long. **Inflorescences** solitary or paired, *axillary or on twigs behind the leaves*; peduncle 0.7–3.5 cm long, pubescent. **Male heads** cylindrical, 2–4 cm long, wrinkled; perianth *c.* 0.4 mm long, deeply bilobed; stamens *c.* 0.5 mm long, filaments cylindrical, anthers ellipsoid, *c.* 0.2 mm long. **Female flowers** with exserted styles. **Syncarps** *axillary or borne on twigs behind the leaves*, ellipsoid to subglobose, *c.* 4.5 × 3.5 cm, *surface* hairy, smooth or *areolate*, or covered by contiguous, low, umbonate processes 2–3 mm across; peduncle 1.5–5.8 cm long, pubescent.

Vernacular names. Sabah—*pudu* (Dusun, preferred name). Sarawak—*pudau* (Malay, Iban), *pudu* (Iban), *pupud*, *selibut* (Kayan), *puduh* (Bidayuh), *puroh* (Berawan).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. Very common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, often in swampy habitats, up to 1000 m altitude.

Uses. The timber is known as *terap* and is used for making household utensils and door/window frames. The latex is used for preparing bird-lime, and the fruits are edible.

11. **Artocarpus lanceifolius** Roxb.

(Latin, *lanci-* = lance-shaped, *folium* = leaf; the lance-shaped leaves)

Fl. Ind., ed. Carey 3 (1832) 527; King *in* Hooker *f.*, Fl. Br. Ind. 5 (1888) 543, Ann. Roy. Bot.Calc. 2 (1889) 3; Ridley *l.c.* (1924) 354; Foxworthy, Mal. For. Rec. 3 (1927) 128; Burkill *l.c.* 256; Jarrett *l.c.* (1959) 140; Kochummen *l.c.* 129; Anderson *l.c.* 255; Primack *l.c.* 34; Corner *l.c.* (1988) 519; Whitmore, Tantra & Sutisna *l.c.* 237; PROSEA *l.c.* (1995) 67; Turner *l.c.* 347; Coode *et al.* (eds.) *l.c.* 211; Argent *et al.* (eds.) *l.c.* 436. **Type:** *Drawing by Wight* (1843). **Synonyms:** *A. clementis* Merr., J. Str. Br. Roy. As. Soc. 85 (1922) 164; *A. lanceifolius* Roxb. subsp. *clementis* (Merr.) Jarrett *l.c.* (1959) 142, *syn. nov*.

Tree up to 35 m tall, 90 cm diameter, occasionally with low buttresses. **Bark** dark grey, smooth to scaly; inner bark yellowish white. **Twigs** 6–8 mm thick, rugose, appressed hairy, minutely punctate. **Stipules** *amplexicaul*, ovate or lanceolate, acute, 1.5–4.5 cm long, appressed pubescent with short hairs. **Leaves** *simple*, *spirally arranged*, *thick-coriaceous*, *entire in adult trees*, *deeply pinnately incised with equal segments in juvenile trees, glabrous on both surfaces*, *drying grey-green*; elliptic to ovate, obovate or oblong, rarely lanceolate to elliptic, 10–33 × 5–17 cm, base cuneate, asymmetric, *margin undulate*, *apex acute or obtuse*; *midrib raised above*; *lateral veins* 7–14 pairs, *raised on both surfaces*; intercostal venation scalariform, very faint below, invisible above; petiole 1–3 cm long. **Inflorescences** solitary or paired, axillary; bracts with funnel-shaped upper parts; peduncle 2.5–7 cm, short-hairy. **Male head** ellipsoid to cylindrical, 3–6 × 1.2–1.8 cm. **Female heads** with peltate bracts; female flowers with exserted bifid styles. **Syncarps** subglobose, 8–12 × 7 cm, olive- or chestnut-brown, tessellate by hardened truncate processes; peduncle 5–10 cm long; fleshy perianth whitish.

Vernacular names. Sarawak—*kaliput*, *pala tupai* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. Widely distributed in Sabah; rare in Sarawak, recorded only for Belaga (Dulit Ranges) and Kapit districts. Also in Brunei and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, up to 300 m altitude, very rarely up to 1800 m.

Uses. The pulp surrounding the seeds is edible. An important source of *keledang* timber which is used in heavy construction, furniture manufacture, boat-building, and for making household utensils and coffins.

12. **Artocarpus longifolius** Becc.

(Latin, *longus* = long, *folium* = leaf; long-leaved)

For. Born. (1902) 629; Merrill *l.c.* (1921) 219; Masamune *l.c.* 240; Jarrett (1960) *l.c.* 83; Anderson *l.c.* 255; Primack *l.c.* 35; Whitmore, Tantra & Sutisna *l.c.* 237; Turner *l.c.* 347; Coode *et al.* (eds.) *l.c.* 211. **Type:** *Teijsmann HB 11312*, Borneo (holotype FI).

Tree up to 12 m tall, 30 cm diameter. **Bark** reddish brown, smooth. **Twigs** 4–6 mm thick, densely pubescent with reddish brown hairs. **Stipules** *non-amplexicaul*, lanceolate, 0.5–1.5 cm long, *persistent*. **Leaves** *simple*, *distichous*, upper surface glabrous except for the hairy veins, *lower surface soft-hairy*; oblanceolate, oblong or narrowly obovate, 11–36.5 × 4.5–16 cm, base attenuate, *margin entire*, *plane*, apex acuminate, acumen up to 2 cm long; midrib flat above; *lateral veins* 11–15 pairs, looping near the leaf margin, raised below, *sunken above*; *intercostal venation scalariform or reticulate*, raised below, *sunken above*; petiole 0.3–0.7 cm long, hairy. **Inflorescences** solitary, axillary; bracts slenderly stalked, with peltate upper parts; peduncle 1.2–3 cm long, soft-hairy. **Male heads** obovoid, 0.8–2 cm long; perianth comprises 3 free tepals, stamens *c.* 0.5 mm long, filaments broad, constricted at the upper parts, anthers globose, *c.* 0.2 mm across. **Female flowers** with exserted styles. **Syncarps** ellipsoid, *c.* 2 cm diameter (immature), surface almost smooth, soft-hairy; peduncle 3–6 cm long, soft-hairy.

Distribution. Endemic to Borneo; rare in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp and *kerangas* forests, up to 100 m altitude.

13. **Artocarpus melinoxylus** Gagnep.

(Greek, *melinos* = yellowish, *xylon* = wood; the yellowish wood)

Bull. Soc. Bot. France 73 (1926) 87; Jarrett *l.c.* (1959) 143; Anderson *l.c.* 355; Whitmore, Tantra & Sutisna *l.c.* 238; Coode *et al.* (eds.) *l.c.* 211. **Lectotype** (Jarrett, 1959)**:** *Poilane 7079*, Indo-China, Ba Na (holotype P; isotype A).

Distribution. Indo-China and Borneo.

Two subspecies, subsp. *melinoxylus* and subsp. *brevipedunculatus* are recognised, of which only the latter is known in Sabah and Sarawak.

subsp. **brevipedunculatus** Jarrett

(Latin, *brevi-* = short, *pedunculatus* = furnished with stalk; the short-stalked inflorescences)

J. Arn. Arb. 40 (1959) 144; Anderson *l.c.* 255; Primack *l.c.* 35; Whitmore, Tantra & Sutisna *l.c.* 238; Coode *et al.* (eds.) *l.c.* 211. **Type:** *Wood SAN A 1733*, Borneo, Sabah, Beaufort district (holotype A; isotypes BO, BRI, K, KEP, L, SING).

Tree up to 25 m tall, 40 cm diameter. **Twigs** (3–)5(–7) mm thick, rugose, hispid with appressed, yellow hairs. **Stipules** *amplexicaul*, ovate, acute, 1–2.5 cm long, appresssed yellowish hairy. **Leaves** *simple*, *spirally arranged*, upper surface glabrous or with scattered hairs on the veins, *lower surface densely rough short-hairy*, especially on the veins; elliptic to narrowly obovate, *(7.5–)14–20 × (3.5–)6–10 cm*, base cuneate, *margin entire*, *plane*, *apex obtuse to acute*; *midrib flat above*; *lateral veins* 7–9 pairs, *flat above*; invenation reticulate, visible on both surfaces; petiole 1–1.5 cm long. **Inflorescences** solitary, axillary; bracts stoutly stalked, upper parts peltate; peduncle 8–20 cm long, hairy. **Male heads** subglobose, 1.5–2.5 cm across; perianth 2–3-lobed, *c.* 0.8 mm long, stamens *c.* 1.5 mm long, anthers globose, *c.* 0.1 mm across. **Female**

heads with peltate bracts; female flowers with exserted styles. **Syncarps** subglobose, *c.* 4 cm across, *surface almost smooth* or covered by low, hardened, cylindrical, obtuse, hispid-hairy processes *c.* 3 × 2 mm; peduncle 2–4 cm long, hairy. **Seeds** ellipsoid *c.* 1 × 0.6 cm.

Vernacular names. Sarawak—*pala munsoh*, *pala tupai*, *temponek* (Iban).

Distribution. Endemic to Borneo; common in Sabah, less frequent in Sarawak. Also in Brunei.

Ecology. In lowland and hill mixed dipterocarp forests, up to 500 m altitude.

14. **Artocarpus nitidus** Tréc.

(Latin, *nitidus* = shinning; the leaf upper surface)

Ann. Sci. Nat. Bot. 3, 8 (1847) 119; Elmer *l.c.* 624; Jarrett *l.c.* (1960) 121; Kochummen *l.c.* 131; Anderson *l.c.* 255; Primack *l.c.* 37; Corner *l.c.* (1988) 520; Whitmore, Tantra & Sutisna *l.c.* 238; PROSEA *l.c.* (1995) 68; Turner *l.c.* 347; Coode *et al.* (eds.) *l.c.* 210; Argent *et al.* (eds.) *l.c.* 436. **Lectotype** (Jarrett, 1960)**:** *Cuming 1078*, the Philippines, Luzon, Albay (holotype P; isotypes BM, CGE, K, L, SING). **Synonyms:** *A. lanceolata* Tréc. *l.c.* 121; *A. humilis* Becc. *l.c.* 629, Merrill *l.c.* (1921) 214, Masamune *l.c.* 239; *A. lamellosa auct.*, *non* Blanco: Merr., Publ. Govt. Lab. Manila 27 (1905) 80; *A. sampor* Gagnep., Bull. Soc. Bot. Fr. 73 (1926) 90; *A. lingnanensis* Merr., Lignan Sci. J. 7 (1931) 302, type: *Balansa 4112*, Tonkin (P); *A. nitidus* Tréc. subsp. *lingnanensis* (Merr.) Jarrett *l.c.* (1960) 124, *syn. nov*.; *A. nitidus* Tréc. subsp. *humilis* (Becc.) Jarrett *l.c.* (1960) 126, Primack *l.c.* 38, Whitmore, Tantra & Sutisna *l.c.* 238; *A. borneensis* Merr., J. Str. Br. Roy. As. Soc. 85 (1922) 165, type: *Ramos 1592*, Borneo, Sabah (A, BM, BO, K, L, P, SING); *A. nitidus* Tréc. subsp. *borneensis* (Merr.) Jarrett *l.c.* (1960) 127, Primack *l.c.* 38, Whitmore, Tantra & Sutisna *l.c.* 238, *syn. nov*.; *A. gomeziana* Wall. var. *griffithii* King *in* Hooker *f.*, Fl. Brit. Ind. 5 (1888) 544, syntypes: *Griffith 4665*, *King's Collectors 6651*, *7533*, *Scortechini* 683 (K, SING); *A. griffithii* (King) Merr., Pap. Mich. Acad. 1, 24 (1939) 64, *A. nitidus* Tréc. subsp. *griffithii* (King) Jarrett *l.c.* (1960) 128, *syn. nov.*

Tree up to 35 m tall, 70 cm diameter, with buttresses up to 1 m tall. **Bark** reddish brown, smooth to shallowly fissured. **Twigs** 1–4 mm thick, smooth or finely rugose, appressed hairy, early glabrescent. **Stipules** *non-amplexicaul*. **Leaves** *simple*, *distichous*, thin to thick-coriaceous, upper surface glabrous, *shining*, *lower surface glabrous or sparsely hairy*; elliptic, obovate or oblong, 3.5–23 × 1.5–9 cm, base cuneate or rounded, *margin entire*, *plane*, *apex obtuse or acute*; *midrib appressed short-hairy below*, *raised above*; *lateral veins* 5–15 pairs, *appressed short-hairy below*, *raised and distinct on both surfaces*; *intercostal venation* reticulate, including the areoles *distinctly visible on both surfaces*; petiole 0.5–2.5 cm long. **Inflorescences** solitary or paired, *axillary*; bracts with slender stalk, upper parts peltate, ciliate; peduncle up to 0.3 cm long. **Male heads** oblong or club-shaped, 0.3–1.2 cm long; perianth with 2–4 free tepals or fused at the base, 0.5–0.7 mm long; stamens 0.8–1 mm long, filaments broad, tapering or contracted at the upper parts, anthers ellipsoid, *c.* 0.2 mm long. **Female heads** with scattered bracts; femaleflowers with exserted styles, up to 0.5 mm long. **Syncarps** *axillary*, subglobose, 1.5–6 cm across, surface smooth or often irregularly swollen, hairy or glabrous; peduncle 0.15–2 cm long. **Seeds** subglobose to ovoid, 0.8–1 × 0.7–0.8 cm.

Vernacular names. Sabah—*beruni* (Dusun). Sarawak—*dadak*, *empaka*, *karon* (Bidayuh), *ngidunuk* (Bidayuh, Bau), *selangkin* (Iban), *sinojoh* (Bidayuh, Padawan), *taburakin* (Bidayuh, Sadong).

Distribution. A very variable species occurring in Assam, Burma, Thailand, Indo-China, Southern China, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. Very common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland to lower montane forests, up to 1500 m altitude.

Uses. The timber is categorized as *terap* and is used in house-building and light contruction. The fruit is edible but not very tasty.

Taxonomy. Jarrett (*l.c.* 121) recognised 4 subspecies, viz. subsp. *borneensis,* subsp. *griffithii,* subsp. *lingnanensis,* and subsp. *nitidus*, based on the presence or absence of indumentum on the syncarp and its colour. However, after going through all the collections from Sabah and Sarawak, I have concluded that the differences are not consistent, and that there are no vegetative characters which can be used to distinguish the subspecies. Therefore, *A. nitidus* is here treated as a widely distributed, vegetatively variable species.

15. **Artocarpus obtusus** Jarrett

(Latin, *obtusus* = blunt; the blunt leaf apex)

Blumea 22 (1975) 410; Anderson *l.c.* 255; Primack *l.c.* 39; Whitmore, Tantra & Sutisna *l.c.* 238. **Type:** *Anderson S. 15740,* Borneo, Sarawak, Semengoh Arboretum (holotype K; isotypes CGE, L, SAR).

Tree up to 35 m tall, 60 cm diameter. **Twigs** up to 5 mm thick, rugose, subglabrous. **Stipules** *amplexicaul*, 1–4 cm long, appressed hairy. **Leaves** *simple*, *spirally arranged*, glabrous, rarely appressed hairy below; elliptic or obovate, 8–23 × 4–8 cm, base broadly cuneate, *margin entire*, *plane*, *apex rounded*; *midrib raised above*; *lateral veins* 4–6 pairs, *flat above*; *intercostal venation finely reticulate*, faint below, almost invisible above; petiole 2–2.5 cm long. **Male heads** ovoid to subconical, *c.* 2.5 × 1 cm, irregularly wrinkled with short narrow grooves; peduncle 1.2–2.5 cm long; perianth *c.* 0.7 mm long, bilobed, finely hairy. **Female flowers** with exserted, unequally bifid styles. **Syncarps** ellipsoid, *c.* 8 × 6 cm, covered by fleshy, hairy processes of two lengths, the longer ones flexuous, *c.* 10 × 3 mm, and the shorter ones conical and rigid, 2–4 × 2 mm; peduncle 3–7.5 cm long, hairy. **Seeds** reniform to subglobose, *c.* 1.5 × 1.2 cm.

Distribution. Endemic to Borneo; very rare, known only by 4 collections from Sarawak (Sibu, Mukah, Bintulu and Kuching districts). A sterile collection, *SAN 56056*, from Beaufort district in Sabah probably belongs here.

Ecology. In lowland mixed dipterocarp, peatswamp and freshwater swamp forests.

16. **Artocarpus odoratissimus** Blanco

(Latin, *odoratus* = strongly sweet-smelling; the fragrant ripe fruits)

Fl. Filip. (1837) 671; Merrill, Spec. Blanc. (1918) 124, *l.c.* (1921) 219; Masamune *l.c.* 240; Jarrett *l.c.* (1959) 147; Anderson *l.c.* 255; Primack *l.c.* 40; Whitmore, Tantra & Sutisna *l.c.* 238; PROSEA 2 (1991) 94; Coode *et al.* (eds.) *l.c.* 211; Argent *et al.* (eds.) *l.c.* 437. **Neotype** (Merrill, 1918)**:** *Merrill Spec. Blanc. 1019*, the Philippines, Mindoro (BM, L). **Synonym:** *A. tarap* Becc. *l.c.* 626; *A. mutabilis* Becc. *l.c.* 627.

Tree up to 25 m tall, 50 cm diameter. **Bark** dark greyish brown, smooth; inner bark yellowish brown. **Twigs** 4–15 mm thick, smooth or ridged, sparsely to densely pubescent with yellow to reddish brown patent hairs. **Stipules** *amplexicaul*, ovate, acute, 1–8 cm long, hispid-pubescent with yellow to reddish brown, appressed or patent hairs. **Leaves** *simple*, *spirally arranged*, *densely rough-hairy on both surfaces*; broadly elliptic to obovate, *16–50 × 11–28 cm*, base cuneate, *margin entire*, *plane or undulate*, *apex acuminate*; *midrib raised above*; *lateral veins* 9–15 pairs, looping near the leaf margin, *raised on both surfaces*; intercostal venation scalariform, raised below, faint above; *petiole 1–3 cm long*, hairy. *Leaves of juvenile trees pinnately lobed*. **Inflorescences** solitary, axillary; bracts with peltate upper parts; peduncle 2.5–7 cm long, hairy. **Male heads** ellipsoid to club-shaped, 4–9 × 2.5–3.5 cm; perianth tubular, *c.* 2 mm long, shortly bilobed, minutely pubescent; stamens *c.* 2 mm long, filaments cylindrical, slender, anthers subglobose, *c.* 0.2 mm long. **Female heads** with pubescent peltate bracts; female flowers with exserted styles. **Syncarps** *subglobose*, to 16 × 13 cm, greenish yellow, drying pale reddish brown, *covered by closely set*, *rigid*, *cylindrical*, *hispid-pubescent processes 8–13 × 1 mm*, fleshy part of perianth white, juicy; peduncle 5.5–16 cm long, hairy. **Seeds** ellipsoid, *c.* 1.2 × 0.8 cm.

Vernacular names. Sabah—*timadang* (Dusun, preferred name). Sarawak—*keiran* (Kelabit), *pingan*, *tekalong* (Iban), *terap* (Malay, preferred name).

Distribution. Endemic to Borneo. Common in Sabah and Sarawak. Also in Brunei and Kalimantan. Introduced and commonly cultivated in the Philippines.

Ecology. In primary and secondary lowland and hill mixed dipterocarp forests on sandy clay soils, up to 1000 m altitude.

Uses. Commonly cultivated in villages for the sweet edible aromatic pulp surrounding the seeds. Young fruits are cooked and eaten as vegetable. Seeds may be eaten after roasting. In Sarawak, the latex is used to treat inflammation from wounds.

17. **Artocarpus peltatus** Merr. Fig. 4.

(Latin, *peltatus* = shield-shaped; the peltate leaves)

J. Str. Br. Roy. As. Soc. 85 (1922) 166; Masamune *l.c.* 240. **Type:** *Villamil 168*, Borneo, Sabah, Sandakan district (holotype PNH; isotype BO).

Tree up to 35 m tall, 60 cm diameter. **Bark** reddish brown, scaly. **Twigs** *3–8 mm thick*, ridged, *densely reddish brown hairy*. **Stipules** *non-amplexicaul*. **Leaves** *simple*, *distichous*,

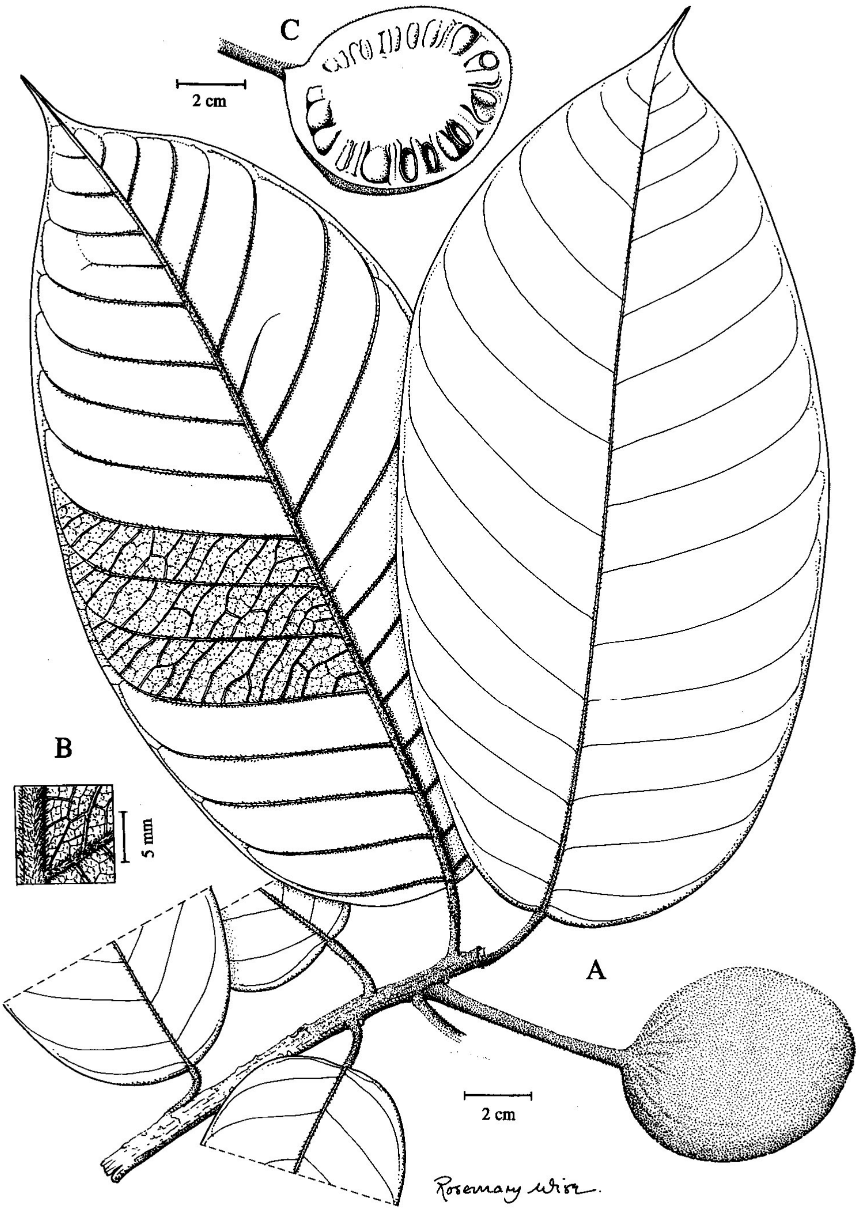

Fig. 4. *Artocarpus peltatus*. A, leafy twig with an almost ripe syncarp; B, detail of lower leaf surface; C, longitudinal section of an almost ripe syncarp. (From *Ilias S. 27020.*)

upper surface glabrous except for sparse hairs on the midrib and veins, *lower surface densely reddish brown soft-hairy*; obovate to elliptic or oblong, 15–35 × 7–18 cm, base rounded, asymmetric, sometimes subcordate, *often narrowly peltate*, *margin entire*, *plane*, *apex acute*; *midrib flat above*; *lateral veins* 11–19 pairs, looping and joining near the leaf margin, raised below, *flat above*; intercostal venation scalariform or reticulate, distinct below, faint above; petiole 1.3–3 cm long, hairy. **Inflorescences** solitary, axillary; bracts with peltate apical parts, up to 0.4 mm across; peduncle 3.5–5 cm long, *reddish brown hairy*. **Male heads** obovoid, 1.5–3.5 × 1–2.5 cm; perianth comprises 2 free tepals *c.* 0.4 mm long; stamens *c.* 0.8 mm long. **Female flowers** with exserted styles. **Syncarps** obovoid or subglobose, up to 7 cm diameter, yellow-green, *surface smooth*, pubescent; *peduncle 4–7.5 cm long*, *reddish brown hairy*. **Seeds** ellipsoid, *c.* 1 × 0.8 cm.

Distribution. Endemic to Borneo. Common in Sarawak; very rare in Sabah, known by single collection, *SAN 76283*, from Kota Belud district. Not known in Brunei and Kalimantan.

Ecology. In lowland forest, at about 200 m altitude.

18. **Artocarpus primackiana** Kochummen

(Richard B. Primack, Boston University, U.S.A., who wrote the “Forester’s Guide to the Moraceae of Sarawak”)

Gard. Bull. Sing. 50 (1998) 199. **Type:** *Aban SAN 99596*, Borneo, Sabah, Kota Merudu district (holotype SAN; isotype KEP).

Small to medium-sized tree, rarely up to 33 m tall, 50 cm diameter; buttresses up to 3.3 m high. **Bark** grey-brown or orange-brown, smooth to cracking. **Twigs** 5–7 mm thick, covered with short rough hairs. **Stipules** *non-amplexicaul*, ovate, *c.* 0.4 cm long, hairy outside. **Leaves** *simple*, *distichous*, upper surface glabrous except the midrib, *lower surface rough-hairy*, *often glaucous*; oblong or obovate, 12–33 × 7.5–19 cm, base cuneate or rounded, *margin entire*, *plane*, *apex acuminate*, acumen up to 1 cm long; midrib flat above; *lateral veins* 10–16 pairs, prominently raised below, *sunken above*; intercostal venation scalariform, raised below, faint above; *petiole 2–5.5 cm long*, short-hairy, often glaucous. **Inflorescences** solitary, axillary; bracts numerous with peltate upper parts. **Male heads** globose, *c.* 1.8 cm diameter, sessile or with *c.* 0.5 cm long hairy peduncle; perianth 3-lobed, covered with short hairs; stamen one, exserted with stout filament. **Female flowers** with exserted, 3-lobed styles. **Syncarps** sessile or short-peduncled, subglobose, *c.* 6 cm across, *surface warty*, velvety hairy, pale yellow with pink flesh when ripe.

Vernacular names. Sabah—*beruni* (Dusun). Sarawak—*dadah* (Iban).

Distribution. Endemic to Sabah and Sarawak. Most collections are from Sabah, where it is widely distributed. In Sarawak, only known by one collection, *S. 43409*, from the G. Mulu NP, Miri district.

Ecology. In lowland and hill mixed dipterocarp forests, up to 600 m altitude.

Notes. Differs from *A. tomentosulus* in the rough-hairy large leaves with sunken lateral veins, small ovate stipules and in the sessile or shortly stalked syncarp. Jarrett (*l.c.* 1960) cited a specimen, *Wood SAN A 3684*, along with the type from Sabah. In view of the large leaves and glabrous nature of the intercostal venation, she suggested that the specimen was taken from a juvenile shoot. However, this specimen was collected from a 13 m tall tree.

19. **Artocarpus rigidus** Blume Fig. 5.

(Latin, *rigidus* = rigid; processes of the syncarp)

Bijdr. Fl. Ned. Ind. (1825) 482; King *in* Hooker *f. l.c.* (1888) 540, *l.c.* (1889) 8; Merrill *l.c.* (1921) 220; Ridley *l.c.* 352; Masamune *l.c.* 240; Jarrett *l.c.* (1959) 150; Backer & Bakhuizen *f. l.c.* 18; Browne *l.c.* 353; Kochummen *l.c.* 131; Anderson *l.c.* 256; Primack *l.c.* 41; Corner *l.c.* (1988) 521; Whitmore, Tantra & Sutisna *l.c.* 238; Kessler & Sidiyasa *l.c.* 175; Turner *l.c.* 348; PROSEA *l.c.* (1995) 69; Argent *et al.* (eds.) *l.c.* 437. **Type:** *Blume s.n.* (= *RHL Sheet No. 908185863*), Java (holotype L). **Synonyms:** *Radermachia rotunda* Houtt., Nat. Hist. Pl. 11 (1779) 455; *A. rotunda* (Houtt.) Panz. *in* Panzer & Christmann, Planzensyst. 10 (1783) 380, Backer & Bakhuizen *f. l.c.* 18; *A. cuspidatus* Griff., Not. Pl. Asiat. 4 (1854) 400; *A. kertau* Zollinger *ex* Miq. *in* Zollinger, Syst. Verz. 2 (1854) 89, 95; *A. dimorphophylla* Miq. *l.c.* (1861) 417; *A. varians* Miq. *l.c.* (1861) 417.

Tree up to 45 m tall, 90 cm diameter, with buttresses up to 3 m tall. **Bark** dark grey, smooth, fissured to scaly. **Twigs** 2–6 mm thick, smooth or rugose, *densely or sparsely hispid-pubescent with reddish brown hairs*. **Stipules** *amplexicaul*, ovate or lanceolate, acute, 0.5–3 cm long, *hispid-pubescent with yellow to reddish brown hairs*. **Leaves** *simple*, *spirally arranged*, upper surface sparsely hairy, *lower surface densely rough-hairy*; elliptic to ovate, obovate or oblong, *9–32 × 4–10 (–15) cm*, base cuneate to rounded, *margin faintly toothed towards apex*, *apex acute*; *midrib raised above*; *lateral veins* 9–20 pairs, raised below, *flat or sunken above*; intercostal venation scalariform or reticulate, raised below, very faint above; *petiole 1–3 cm long*. *Leaves of juvenile trees pinnately lobed*. **Inflorescences** solitary, axillary; bracts with peltate upper parts *c.* 0.3 mm across, shortly ciliate; peduncle 0.2–0.6 cm long, densely appressed hairy. **Male heads** obovoid to subglobose, 1.3–2 cm across; perianth tubular, *c.* 1 mm long, shortly bilobed, minutely hairy; filaments slender, cylindric, anthers globose, *c.* 0.1 mm long. **Female heads** with caducous, pubescent, peltate bracts; female flowers with simple exserted styles. **Syncarps** globose, up to 13 cm diameter, dull orange, *surface strongly spiny by the closely set*, *rigid*, *tapering*, *acute*, *hispid-pubescent processes 7–9 × 2 mm*; pulp around the fruit orange, fleshy, sweet; peduncle up to 4 cm long.

Vernacular names. Sarawak—*pala munsoh*, *pudau*, *temponek* (Iban).

Distribution. S Burma, S Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, Kangean Archipelago, and Bali. Common and widely distributed in Sabah and Sarawak. Also in Kalimantan.

Ecology. In peatswamp, freshwater swamp, limestone hill, lowland and hill mixed dipterocarp forests on diverse soils, up to 1000 m altitude.

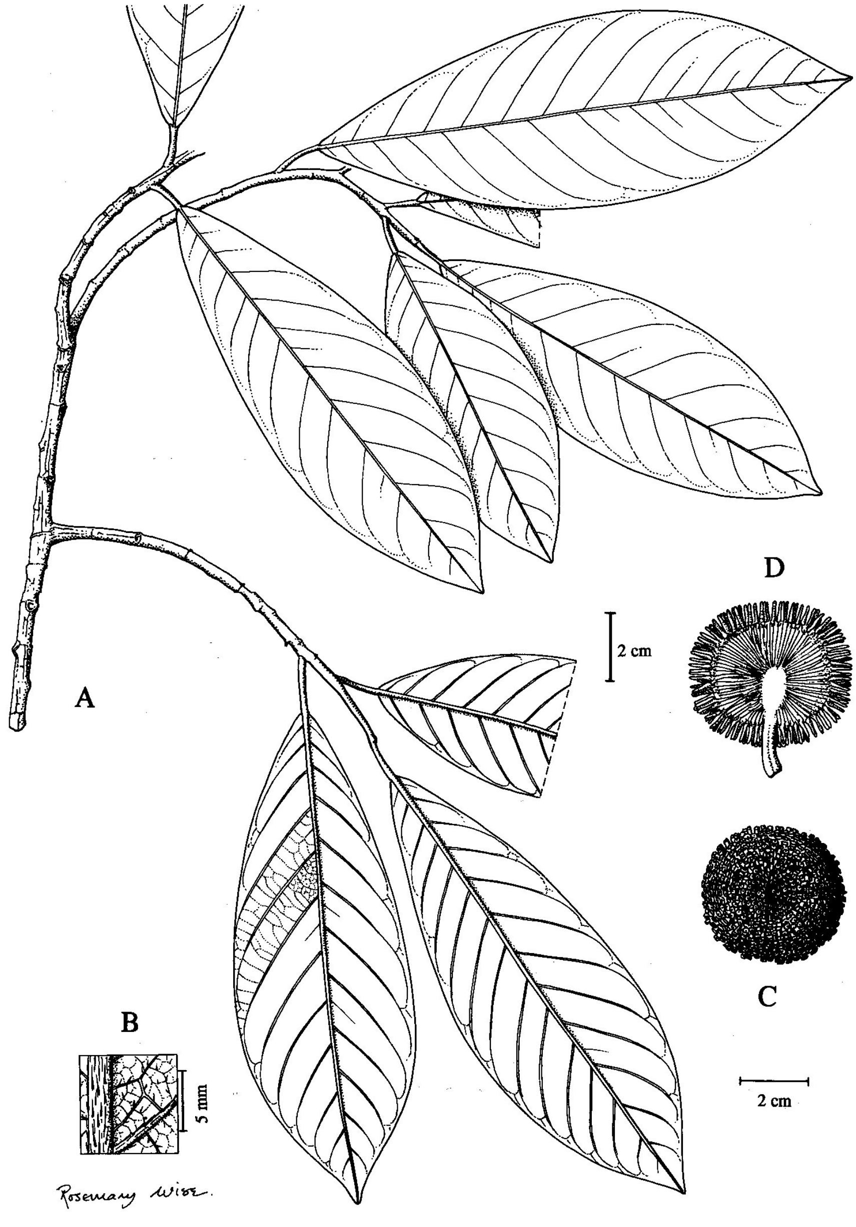

Fig. 5. *Artocarpus rigidus*. A, leafy twig; B, detail of lower leaf surface; C, surface view of a young syncarp; D, longitudinal section of a young syncarp. (From *Ashton S. 18853.*)

Uses. Cultivated for the edible sweet pulp surrounding the seeds. The timber is classified as *beruni* or *selangking* and is used for making beams, furniture and boats.

20. **Artocarpus sarawakensis** Jarrett
(of Sarawak)

Blumea 22 (1975) 410; Primack *l.c.* 42. **Type:** *Ilias S. 15109*, Borneo, Sarawak, Bintulu district, Segar FR (holotype K; isotypes C, L, SAN, SAR).

Tree up to 25 m tall. **Twigs** up to 10 mm thick, rugose, *hispid-pubescent with tawny subpatent hairs 4–7 mm long*. **Stipules** *amplexicaul*, up to 10 cm long, *densely hispid-pubescent*. **Leaves** *simple*, *spirally arranged*, upper surface glabrous except for scattered long hairs along the lateral veins, lower surface pubescent with short, rough, appressed hairs; elliptic, *30–50 × 18–25 cm*, base cuneate, *margin lobed*, apex cuspidate; midrib flat above; *lateral veins* 12–17 pairs, raised below, *sunken above*; intercostal venation scalariform or reticulate, visible below, very faint above; *petiole 1–2 cm long*, *hispid-pubescent.* **Male heads** obovoid to ellipsoid, 3–6 × 1.5–2.5 cm; peduncle 4–8 cm long, scabrid with scattered long hairs; bracts slenderly stalked, upper parts peltate; perianth *c.* 0.8 mm long, stamens *c.* 1 mm long, anthers globose, *c.* 0.1 mm long. **Female flowers** with simple exserted styles *c.* 2 mm long. **Syncarps** subglobose, *c.* 5 cm across, surface covered with hardened, cylindrical, obtuse hairy processes *c.* 5 × 2 mm; peduncle up to 5.5 cm long, pubescent with scattered long hairs. **Seeds** ellipsoid, *c.* 1.3 × 0.8 cm.

Vernacular names. Sarawak—*pedalai*, *pingan* (Iban).

Distribution. Endemic to Borneo. Uncommon in Sarawak, not yet reported for Sabah. Not known in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp forest on ridges, up to 300 m altitude.

21. **Artocarpus tamaran** Becc.
(from the Iban name of the tree—*tamaran*)

For. Born. (1902) 626; Merrill *l.c.* (1921) 220; Masamune *l.c.* 240; Jarrett *l.c.* (1959) 352; Anderson *l.c.* 256; Primack *l.c.* 42; Whitmore, Tantra & Sutisna *l.c.* 239; PROSEA *l.c.* (1995) 71; Coode *et al*. (eds.) *l.c.* 211; Argent *et al.* (eds.) *l.c.* 437. **Type:** *Beccari PB 2996*, Borneo, Sarawak (holotype FI; isotype L).

Tree up to 40 m tall, 100 cm diameter; buttresses up to 3 m high. **Bark** grey-brown, smooth. **Twigs** 5–10 mm thick, rugose, *sparsely pubescent with scattered*, *patent*, *reddish brown hairs up to 5 mm long*. **Stipules** *amplexicaul*, lanceolate, acute, 3–18 cm long, covered with reddish brown, subappressed hairs. **Leaves** *simple*, *spirally arranged*, upper surface glabrous, *lower surface appressed hairy*; ovate or elliptic, *20–35 × 11–18 cm*, base rounded, *margin lobed*, apex acute; midrib raised above; *lateral veins* 15–23 pairs, raised below, *sunken above*; intercostal venation scalariform, visible below, faint above; *petiole 3.5–4.5 cm long*, *reddish brown hairy*. *Leaves of juvenile trees up to 100 cmlong*, *deeply pinnately lobed*. **Inflorescences** solitary, axillary. **Male heads** cylindrical, 7 × 1–1.5 cm, surface tuberculate with many irregular, cylindrical, obtuse, solid processes *c.* 3 × 2 mm; peduncle 3.5–5.5 cm long, hairy; perianth tubular, *c.* 0.6 mm long, bilobed, minutely pubescent, stamen filaments flat, abruptly contracted on the upper portions, anthers oblong, *c.* 0.2 mm long. **Female flowers** with exserted styles *c.* 0.5 mm long. **Syncarps** cylindrical to subglobose, *c.* 10 × 5 cm, dark brown, covered by closely set, fleshy processes of two lengths; peduncle 5.5–13 cm long, hairy. **Seeds** ellipsoid, *c.* 0.6 × 0.4 cm.

Vernacular names. Sabah—*timbangan* (Dusun, preferred name). Sarawak—*kakang*, *tamaran*, *tembaran* (Iban), *kalong*, *kihan* (Kayan).

Distribution. Endemic to Borneo. Widely distributed in Sabah; less common in Sarawak and recorded from Bintulu, Kapit and Lundu districts. Also in Brunei and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, up to 600 m altitude.

Uses. Cloth is made from the bark. The timber is traded and used as *terap*.

22. **Artocarpus teysmannii** Miq.

(J.E. Teijsmann, 1802–1882, former curator of the Bogor Botanic Gardens)

Fl. Ind. Bat., Suppl. (1861) 418; Jarrett *l.c.* (1959) 341; Anderson *l.c.* 256; Primack *l.c.* 43; Whitmore, Tantra & Sutisna *l.c.* 239; PROSEA *l.c.* (1995) 71; Turner *l.c.* 348; Argent *et al.* (eds.) *l.c.* 438. **Type:** *Teijsmann HB 4387*, Sumatra, Lampong, Kebong (holotype U; isotypes BO, L). **Synonym:** *A. peduncularis* Kurz, J. Bot. 13 (1875) 331, Beccari *l.c.* 632, Merrill *l.c.* (1921) 219, Ridley *l.c.* (1924) 353, Burkill *l.c.* 258, Corner *l.c.* (1939) 283, Masamune *l.c.* 240.

Tree up to 45 m tall, 80 cm diameter; buttresses up to 2 m tall. **Bark** dark brown, smooth. **Twigs** 3–5 mm thick, rugose, appressed hairy. **Stipules** *amplexicaul*, lanceolate, acute, 2–9 cm long, appressed hairy. **Leaves** *simple*, *spirally arranged*, *thin-coriaceous*, *upper surface glabrous or nearly so*, *lower surface sparsely appressed pubescent on the veins*, *drying reddish brown*; ovate to elliptic, 5–25 × 3–13, base broadly cuneate, *margin lobed or shallowly crenate*, *apex obtuse or acute*; *midrib flat above*; *lateral veins 6–12 pairs*, raised below, *flat above*; intercostal venation scalariform, invisible on both surfaces; *petiole 1–3.5 cm long*. **Inflorescences** solitary, axillary. **Male head** narrowly cylindrical, 3.5–7.5 × 0.5–1 cm; peduncle 2–8 cm long, sparsely appressed hairy; sterile perianth solid, filiform, projecting up to *c.* 1 mm long from the surface, that of fertile male flowers tubular, *c.* 1.4 mm long, bilobed, minutely pubescent; stamens up to 2 mm long, filaments broad, abruptly contracted at the upper parts, anthers oblong, *c.* 0.5 mm long. **Female flowers** with simple projecting styles up to 1.5 mm long. **Syncarps** cylindrical, up to 8.5 × 2.2 cm, yellow, covered by closely set, fleshy, conical, appressed hairy processes *c.* 1.5 × 1.5 mm; peduncle 3–10 cm long, appressed hairy. **Seeds** ellipsoid, *c.* 0.7 × 0.6 cm.

Vernacular name. Sarawak—*chempedak ayer* (Malay).

Distribution. Nicobar Islands, Sumatra, Peninsular Malaysia, Borneo, Sulawesi, Maluku, and W New Guinea. Very rare in Sabah and Sarawak, known by two collections, *SAN 23440* (from Kinabatangan district) and *SAN 40656* (from Sandakan district) from Sabah, and by a few collections from Marudi district, in Sarawak. Also in Kalimantan.

Ecology. In lowland forest, including alluvial swampy habitats.

Uses. The timber is classified as *terap*, and the wood is used for boat-building.

23. **Artocarpus tomentosulus** Jarrett

(Latin, *tomentosulus* = covered with minute, soft, short, matted hairs; the indumentum of the plant parts)

J. Arn. Arb. 41 (1960) 117; Primack *l.c.* 44; Whitmore, Tantra & Sutisna *l.c.* 239. **Type:** *Keith 7671*, Borneo, Sabah, Sandakan district, Kabili-Sepilok FR (holotype SING).

Tree up to 15 m tall, 30 cm diameter. **Twigs** slender, *c. 3 mm thick*, rugose, *pubescent with reddish brown short hairs*. **Leaves** *simple*, *distichous*, upper surface glabrous except for the midrib and lateral veins, *lower surface densely reddish brown soft-hairy*; elliptic or oblong, 14–20 × 8.5–11 cm, base almost rounded, *margin entire*, *plane*, *apex acuminate*, acumen up to 1 cm long; *midrib flat above*; *lateral veins* 9–14 pairs, raised below, *flat above*; intercostal venation scalariform, raised below, invisible above; *petiole* 1–1.8 cm long, *reddish brown hairy*. **Male heads** (not fully developed) globose, *c.* 0.7 cm across, solitary, axillary; bracts minute, stipitate, apex peltate, *c.* 0.4 mm across; peduncle *c.* 0.2 cm long; perianth tubular, *c.* 0.6 mm long, bilobed, minutely hairy; anthers ellipsoid, *c.* 0.2 mm long. **Female heads** not seen. **Syncarps** subglobose, *irregularly lobed*, *c.* 4 cm across, reddish brown velvety hairy, styles simple, slightly projecting; perianth with glandular, broad-based scales; *peduncle 3–5 cm long*.

Distribution. Endemic to Borneo. Only known from Sabah by 3 collections, *Keith 7671* from Sandakan district, and *SAN 96814* and *SAN 116315* from Ranau district.

Ecology. In lowland and hill mixed dipterocarp forests, up to 700 m altitude.

Notes. Jarrett (*l.c.*) had wrongly identified a number of collections from Sabah as belonging to *A. tomentosulus*. They do not match with the type. I have described a new species, *A. primackiana*, based on these collections.

Incompletely known species

Artocarpus sp. ‘A’

Tree up to 24 m tall, 40 cm diameter. **Bark** dark brown, inner bark pale brown. **Female heads** *in clusters* (immature). Known by one collection, *SAN 82081*, from Sepilok Arboretum, Sandakan district, Sabah.

3. **FICUS** L.

(Latin, *ficus* = the fig tree)

ara, kayu ara (Malay)

K.M. Kochummen†

Sp. Pl. (1753) 1059, Gen. Pl. ed. 5 (1754) 482; Blume, Bijdr. Fl. Ned. Ind. (1825); Miquel, Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 214; King, Ann. Roy. Bot. Gard. Calc. 1, 1 & 2 (1887–1888) 1; Merrill, EB (1921) 220; Ridley, FMP 3 (1924) 325, *ibid.* 5 (1925) 333; Corner, J. Mal. Br. Roy. As. Soc. 11 (1933) 1; Elmer, Leafl. Philip. Bot. 9 (1937) 3427; Corner, Gard. Bull. Str. Settl. 10 (1939) 82, Gard. Bull. Sing. 17 (1960) 368, *ibid.* 18 (1960) 1, *ibid.* 19 (1962) 187, *ibid.* 21 (1965) 1; Backer & Bakhuizen *f.*, FJ 2 (1965) 20; Kochummen, TFM 3 (1978) 135; Anderson, CLTS (1980) 256; Wong, DMT (1982) 61; Corner, WSTM 3rd. edition 2 (1988) 521; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 239; Berg, Mem. NY. Bot. Gard. 55 (1990) 169; Ng, Mal. For. Rec. 34, 2 (1991) 453; Rohwer *in* Kubitzki *et al.* (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 452; Coode *et al.* (eds.), CLBD (1996) 211; Argent *et al.* (eds.), MNDT-CK 2 (1997) 438. **Synonyms:** *Covellia* Gasp. *in* Parlatore, Giorn. Bot. 2 (1844) 217; *Sycomorphe* Miq., Ann. Sc. Nat. 3, 1 (1844) 35; *Pharmacosycea* Miq. *in* Hooker, Lond. J. Bot. 6 (1847) 525; *Pogonotrophe* Miq. *l.c.* (1847) 525; *Synoecia* Miq. *in* Hooker, Lond. J. Bot. 7 (1848) 469; *Bosscheria* Teijsm. & de Vries, Nat. Tijds. Ned. Ind. 23 (1861) 212; *Dammaropsis* Warb., Bot. Jahrb. 13 (1891) 296.

Monoecious or dioecious trees, shrubs, woody epiphytes, climbers, stranglers, or creepers; *all parts with white or cream latex*. **Bark** generally greyish, smooth. **Twigs** *often with ring-like stipular scars*. **Stipules** *mostly amplexicaul*, free or sometimes connate, caducous or persistent. **Leaves** simple, alternate (distichous or in spiral) or opposite; margin entire, toothed or lobed, plane or revolute; *basal lateral veins often distinct by departing from the midrib in a more acute angle and/or distinctly longer than the other lateral veins*. **Inflorescences/infructescences** (syconia or figs) with urn-shaped and fleshy receptacles, *enclosing the flowers or fruits*, solitary, in pairs or clustered, arising from the leaf axils, or borne on the twigs behind the leaves down to older branches or stem, or on long runners/stolons arising from the base of stem and trailing along the ground (in geocarpic figs), sessile or peduncled; base of the receptacle sometimes tapered and stalk-like; basal bracts usually 3, lateral bracts sometimes present, interfloral bracts and/or bristles present or absent; apex convex, flat and disc-like or depressed, ostiole closed by overlapping bracts; surface smooth, warty, or wrinkled on drying. **Flowers** small, *unisexual*, numerous, *usually of three kinds*, *male*, *female* and *gall flowers*, *all three in the same syconium* (subgen. *Urostigma*, *Pharmacosycea*, *Sycomorus*), or *male and gall flowers in syconia on one plant and female flowers in syconia of another plant* (subgen. *Ficus*), pedicelled or sessile; tepals 3–5(–7), whitish or reddish, free or more or less united. **Male flowers:** stamens 1–5, usually with distinct, free or united filaments, rarely anthers sessile; rudimentary ovary mostly absent. **Gall flowers** resembling female flowers but with swollen and baloon-like ovaries, shorter style, and not setting seed. **Female flowers** with a single ovary; style relatively long, terminal, subterminal or lateral, stigma entire or divided; ovule one, pendulous. **Fruits** achene-like or rarely drupaceous, tiny, with smooth or tuberculate surface.

Distribution. A large genus with about 800 species, mostly in tropical Africa, Asia, Malesia, Australia, C and S America; very common in the Malesian region. A total of 143 species are recorded for Sabah and Sarawak.

Ecology. Occur in a wide variety of habitats from sea level up to 3200 m altitude, including swamp, limestone, riverine, primary and secondary mixed dipterocarp and montane forests. Epiphytic species infest old trees and crevices of walls of buildings and roof tops, and by their long tough roots, even hold together crumbling rocks, limestone outcrops and other rock-formations. Flowers are pollinated by fig-wasps which are species-specific. The fruits and seeds are dispersed by frugivorous arboreal and terrestrial vertebrates, such as birds, bats, squirrels, primates and wild boars, which consume the brightly coloured or dull-green, fleshy fruiting-syconia, and defecate the hard-coated, tiny seeds at a new place away from the parent trees. Many strangling figs begin their life as epiphytes. Birds, squirrels and monkeys which eat the figs drop the seeds on branches of trees where they germinate and grow into epiphytic bushes. The roots of these new generation of fig plants encircle the branches of the host trees and eventually the whole trunk, forming an anastomosing and interlacing basket. Some aerial roots grow straight down to the ground from various heights. As the fig roots and the supporting trunk of the host tree increase in thickness, they press upon each other, but the fig roots being the stronger, slowly crush the bark of the host tree with the effect that the supporting tree is gradually killed and the fig plant finally stands in its place on a massive basket of roots. Some *Ficus* species are deciduous, shedding their leaves and remaining bare for a few days, usually after pronounced dry weather. *Ficus variegata* sheds its leaves twice a year. Due to their year round fruiting and large crops, fig plants provide resource for a variety of vertebrate frugivores (fruit eaters) and consequently they are regarded as “keystone mutualists” in tropical forests. (P. Stott (ed.), Fig trees and their associated animals, J. Biogeogr. 23, 4 (1996) 405–607).

Uses. *Ara* or *kayu ara* is the common Malaysian name for the timber of *Ficus* species. The timber is soft and light with density ranging from 350–640 kg/m³ air dry. The sapwood is not differentiated from the heartwood which is light yellow-brown or in various shades of yellow to pink-grey. Texture is coarse and uneven, with the grain interlocked. The timber is easy to moderately easy to resaw and easy to cross-cut. Planed surface is smooth and seasoned rapidly. It is prone to sapstain fungal attack. The wood is suitable for low grade plywood, and for making disposable chopsticks, packing cases and wooden sandals. The latex is used in the preparation of bird-lime. Many *Ficus* species are cultivated as ornamental plants. The most common ones are *F. benjamina* and a variety of *F. microcarpa*. Young plants of *F. elastica* are used as indoor pot plants in office buildings because of the shiny dark green leaves and the bright red long stipules. *F. pumila*, a creeper originally from China and Japan, is cultivated to grow over walls of buildings. Many species of *Ficus* in Sabah and Sarawak are suitable for urban landscape plantings. For example, *F. aurantiacea* and *F. punctata* will provide the same, if not better and more colourful appearance than *F. pumila*. Other promising species include *F. deltoidea* and its varieties, *F. oleifolia* and its varieties, and *F. ixoroides*. *F. deltoidea* is a well known plant in traditional medicine in Peninsular Malaysia, Borneo and Indonesia. Decoction of leaves is taken after child birth. Young leaves of *F. grossularioides* are cooked and eaten as vegetable. Rough leaves are sometimes used as sandpaper.

Taxonomy. The genus *Ficus* is divided into 4 subgenera, viz. subgen. *Ficus*, subgen. *Pharmacosycea*, subgen. *Sycomorus* and subgen. *Urostigma*. In Sabah and Sarawak, subgen. *Sycomorus* is represented by only a single species, *F. racemosa*. The species in the other subgenera are again grouped into series, and subseries, based mainly on floral cIn subgen. *Ficus*, the figs (= syconia) containing male and “gall” flowers are found in different trees from the figs containing female or “seed” flowers.

Key to subgenera

1. Plants dioecious; syconia contain either male and short-styled (gall-)flowers or long-styled (seed-)flowers only, the two types of syconia are borne on different plants………………………..……......…………………………..…………..subgen. **Ficus**
   Plants monoecious; syconia contain male, short-style (gall-), and long-styled (seed-) flowers……………………………………………………...………..……….......…………2

2. Plants with aerial adventitious roots, often stranglers. Leaves mostly with a single gland at the base of the midrib beneath. Male flowers with a single stamen. Style with one stigmatic arm……………………..…...…………………………………...……subgen. **Urostigma**
   Plants without aerial adventitious roots, always terrestrial. Leaves often with two glands, one in each of the axils of the basal lateral veins. Male flowers with more than one stamen. Style with 2 stigmatic arms or truncate to elongated stigma………......……………………………3

3. Ovary white or reddish at the stylar side; style with 2 stigmatic arms; interfloral bracts or bristles often present…………………………………………….....subgen. **Pharmacosycea**
   Ovary dark red; style and stigma simple; interfloral bracts or bristles absent…….……… …………………………………………………………........…………subgen. **Sycomorus**

Notes. In the key to *Ficus* species given below, several categories of growth form are used. However, in several groups of *Ficus* the species often develop different growth forms. In the monoecious subgen. *Urostigma*, which can often be recognized by the presence of a single gland (glandular spot) at the base of the midrib beneath, the species produce aerial adventitious roots that enable them to become stranglers. However, young or small plants can be confused with epiphytes. Several species in this group are often terrestrial, and then becoming lianescent or, in open places, developing into trees with short stems and broad crown, and often with aerial roots hanging from the branches which frequently developing into pillar-roots supporting the branches. Within the dioecious subgen. *Ficus* there is a subsection (*Palaeomorphe*), which can often be recognized by the not fully amplexicaul stipules and the arrangement of the “basal” bracts, i.e. often not neatly arranged in a whorl, but occurring more or less scattered on the peduncle. The species of this group also produce aerial adventious roots, and many of them exhibit different habits. They can be terrestrial trees or shrubs or (straggling) climbers, which may become (partly) epiphytic. Some are stranglers anchored close to the forest floor and others can be confused with stranglers. A third group comprising some members of the dioecious subgen. *Ficus* are also capable of producing aerial adventious roots. These species are rather uniform in being root-climbers with short adventious roots arising from the stems. The leaves of the sterile climbing stems are more or less clearly differentiated from those of the spreading fertile branches which usually do not produce adventitious roots. Finally, a small group of the dioecious subgen. *Ficus* comprising *F. deltoidea* and *F. oleifolia* can be terrestrial, epiphytic or epilithic.
The users of the key are, therefore, adviced to try more than one possibility as with regard to habit (at leads 1 and 116) in order to key out material collected from plants with somewhat unusual habits or growth forms.

Key to *Ficus* species

1. Trees or erect shrubs (including some stranglers that develop stems)..........2
Stranglers, climbers, creepers or epiphytes, rarely scandent shrubs..........80

2. Leaves glabrous and smooth..........3
Leaves hairy or scabrous, at least on the midrib below..........38

3. Leaf margin entire or rarely lobed (in some varieties of *F. deltoidea*)..........4
Leaf margin toothed or lobed..........32

4. Midrib sunken above..........5
Midrib raised or flat above..........11

5. Leaves thick-coriaceous, cardboard-like, margin revolute..........**70. F. xylophylla** (in part)
Leaves membranous to coriaceous, margin plane or revolute..........6

6. Lateral veins sunken above..........**50. F. retusa**
Lateral veins flat or raised above..........7

7. Leaves obovate to spathulate, apex rounded..........**59. F. spathulifolia**
Leaves of other shapes, apex acute, acuminate, or rounded..........8

8. Petiole up to 1 cm long..........9
Petiole more than 1 cm long..........10

9. Medium-sized tree. Leaves 9–20 cm long..........**34. F. magnoliifolia**
Shrubs or small trees. Leaves 2.5–10.5 cm long..........**45. F. oleifolia** (in part)

10. Basal pairs of lateral veins not distinct, extending less than 1/3 the length of the blade..........**56. F. septica**
Basal pairs of lateral veins distinct, extending more than 1/3 the length of the blade..........**3. F. ashtonii**

11. Midrib forked..........**15. F. deltoidea** (in part)
Midrib not forked..........12

12. Leaf margin revolute..........13
Leaf margin plane..........17

13. Leaf apex acute..........14
Leaf apex obtuse or rounded..........16

14. Leaf margin lobed..........**15. F. deltoidea** (in part)
Leaf margin entire..........15

15. Twig hollow. Leaves spirally arranged or rarely opposite, base rounded……...**19. F. fistulosa**
Twig solid. Leaves mostly opposite, base cuneate.......….................**47. F. pseudotarennifolia**

16. Syconia covered with long bracts all over its surface. Shrubs of lowland riverbanks…………
………..……….……………………….………..……….............**33. F. macrostyla** (in part)
Syconia without such bracts. Shrubs of montane forest.....…................**45. F. oleifolia** (in part)

17. Lateral veins numerous, closely spaced, more or less straight towards the leaf margin
……………...……………………………………….............……**7. F. benjamina** (in part)
Lateral veins few, well-spaced, curved towards the leaf margin…………......………………18

18. Lateral veins up to 5 pairs; leaf base asymmetric……….........………**64. F. tinctoria** (in part)
Lateral veins more than 5 pairs; leaf base symmetric.......…………….……………………..…19

19. Basal pairs of lateral veins not distinct........…………………………...…………...……...20
Basal pairs of lateral veins distinct........………………………………………………..……..…21

20. Leaf apex cuspidate; glands in the axils of basal pair of lateral veins present. Syconia up to 0.5 cm across, axillary or borne on twigs behind the leaves……….…..**51. F. rubrocuspidata**
Leaf apex caudate; glands in the axils of basal pair of lateral veins absent. Syconia up to 3.75 cm across, borne in massive clusters on branched leafless twigs arising from the stem.…..………………...……………………....….…………………….…..……**54. F. schwarzii**

21. Leaves glaucous below. Syconia borne on stem and branches; tree monoecious……………
……………………………………………………....……………………..**49. F. racemosa**
Leaves not glaucous below. Syconia axillary, or on twigs behind the leaves, or borne on long runners/stolons arising from the base of stem; or if in dense clusters on the stem and branches, then tree dioecious……....………..……………………………………………….22

22. Leaf base auriculate, apex acuminate or caudate, acumen 3–4.5 cm long.......…………….....23
Leaf base not auriculate, apex not so........………………………………………….………..25

23. Midrib rounded below; petiole up to 0.3 cm long. Syconia on stolons arising from the base of stem, with lateral bracts…………...………..……….........................**30. F. leptocalama**
Midrib keeled below; petiole 0.3–1 cm long. Syconia axillary, without lateral bracts.……...24

24. Stipules caducous........……………………………...……………......**38. F. midotis** (in part)
Stipules persistent.......…………………………...……………………....**52. F. rubromidotis**

25. Plants with abundant free hanging aerial roots. Lateral veins steeply ascending, departing from the midrib at an acute angle....…...……………………….…**37. F. microcarpa** (in part)
Plants without free hanging aerial roots. Lateral veins not steeply ascending, departing from the midrib at a broad angle........……….................................………………..…………..26

26. Leaves narrowly oblong or lanceolate, 6–18 × 1.2–3.2 cm; lateral veins 8–16 pairs. Syconia tapered to the base, solitary, axillary. Riverine shrubs...................................…**27. F. ixoroides**
Not this combination of characters.............……………………...……………..…………...27

27. Intercostal venation scalariform……………………………………………………………28
Intercostal venation reticulate…………………………………………………………………30

28. Syconia in clusters on stem and older branches……………………………**67. F. variegata**
Syconia axillary………………………………………………………………………………29

29. Midrib keeled below. Syconia without lateral bracts…………………**68. F. virens** (in part)
Midrib rounded below. Syconia with lateral bracts………………………………**29. F. lepicarpa**

30. Petiole 3.5–7 cm long. Syconia with 2–3 cm long peduncle…………………**10. F. callosa**
Petiole up to 3 cm long. Syconia sessile or with peduncle up to 1.5 cm long……………31

31. Leaves with cream and yellow dots on the upper surface; lateral veins 4–6 pairs. Syconia usually sessile……………………………………………………………**13. F. chartacea**
Leaves without cream and yellow dots on the upper surface; lateral veins 7–13 pairs. Syconia distinctly peduncled……………………………………………………**28. F. lamponga**

32. Midrib of leaf sunken above…………………………………………………**32. F. macilenta**
Midrib of leaf raised or flat above……………………………………………………………33

33. Syconia borne on stem and branches, or on short, leafless twigs arising from the stem, or on stolons…………………………………………………………………………………34
Syconia axillary or on the twigs behind the leaves…………………………………………36

34. Leaf apex caudate, acumen up to 6 cm long. Syconia with many lateral bracts……………
……………………………………………………………………………**31. F. leptogramma**
Leaf apex acute, acuminate or obtuse. Syconia without lateral bracts……………………35

35. Syconia surface ridged, apex depressed………………………………**55. F. scortechinii**
Syconia surface more or less smooth, apex rounded………………………**63. F. tarennifolia**

36. Leaf base with a small auricle on one side…………………………**38. F. midotis** (in part)
Leaf base without an auricle…………………………………………………………………3

37. Leaves narrowly oblong, up to 2.2 cm wide; lateral veins 13–21 pairs……………**12. F. chaii**
Leaves elliptic-oblong, 3.5–9 cm wide; lateral veins 5–8 pairs…………………**58. F. sinuata**

38. Leaf margin crenate, denticulate, serrate, or lobed…………………………………………39
Leaf margin entire………………………………………………………………………………63

39. Leaves often trilobed, glaucous below………………………**24. F. grossularioides** (in part)
Leaves not trilobed, not glaucous below………………………………………………………40

40. Midrib sunken above…………………………………………………………………………41
Midrib raised or flat above……………………………………………………………………43

41. Twig hollow; petiole 7–7.5 cm long……………………….……………...**16. F. diamantiphylla**
Twig solid; petiole up to 2 cm long….……………….…………………………………....42

42. Leaf base strongly asymmetric, rounded on one side, cuneate on the other……………………
……………………..…………………………………………...…..**66. F. uncinata** (in part)
Leaf base symmetric, cuneate.........………………………….……...**65. F. treubii** (in part)

43. Syconia borne on stem or on long, finger-like projections arising from branches and stem...44
Syconia on stolons or runners arising from the base of stem, axillary, or borne on the twigs behind the leaves…….……………………........………………………….…………...46

44. Leaves sessile; base asymmetric, auriculate on one side; lateral veins sunken above……………………………………………….....………………**26. F. hemsleyana**
Leaves with well-developed petiole 1–7 cm long; base cuneate, symmetric; lateral veins raised or flat above….………………………..…………………………….…………...45

45. Twig hollow. Syconia with faint irregular lines and tiny projections, glabrous…………..……
……………………..………………………..………..…**43. F. obpyramidata** (in part)
Twig solid. Syconia with distinct ridges from base to apex, brown short-hairy………………
……………………..……………………………………....……………**69. F. virescens**

46. Syconia on stolons or runners arising from the base of stem…………………….…………..47
Syconia axillary or borne on twigs behind the leaves…………………………………….….50

47. Stipules persistent. Leaf base auriculate on one side…….…………………...**22. F. geocharis**
Stipules caducous. Leaf base not auriculate on one side……..…….….…………….….….48

48. Petiole up to 0.6 cm long. Leaf base symmetric, cuneate….………………..**60. F. stolonifera**
Petiole 0.5–2.5 cm long. Leaf base asymmetric, cordate or cuneate on one side and rounded on the other….………………..…………...……………………………………………49

49. Leaf base cordate; lateral veins 10–24 pairs..…………………………….…**35. F. megaleia**
Leaf base cuneate on one side and rounded on the other; lateral veins 3–13 pairs……………
………….…………………………………...…………………...**66. F. uncinata** (in part)

50. Leaf base rounded, subcordate or truncate. Syconia at least 1 cm across………..……….…51
Leaf base usually cuneate. Syconia usually less than 1 cm across…..…….…………….….54

51. Twig glabrous…….………………………………...……………..….…**8. F. bruneiensis**
Twig hairy…………………………………………....……….……………………….….52

52. Leaves densely velvety hairy on both surfaces……….…………….…...**17. F. endospermifolia**
Leaves not velvety hairy….……………………………………….…………….………...53

53. Leaf margin faintly toothed. Syconia short velvety hairy; basal bracts 0.1–0.15 cm long……………………..………………………....……...……………..**9. F. brunneoaurata**

Leaf margin distinctly toothed. Syconia covered with long hairs; basal bracts 0.3–0.4 cm long……………………………………...……………...…………………**18. F. eumorpha**

54. Leaf margin irregularly lobed…………………...…….…………..…..……….**41. F. montana**
Leaf margin variously toothed………………...…………………………….….………………...55

55. Leaf apex obtuse…………………………......……………………………….………………..56
Leaf apex acute or acuminate or caudate………..……………………………..…………57

56. Leaf surface smooth………………...……………...…………………….….**36. F. melinocarpa**
Leaf surface scabrous (sandpapery to the touch)..………..…...…...…………..**14. F. cumingii**

57. Leaf base asymmetric……………………….…....……………….……...……….....58
Leaf base symmetric…...…………………………......………………….……….……...……..59

58. Twig angled, soft-hairy. Leaves with petiole up to 1 cm long; apex with an acumen of 2–3 cm long. Syconia solitary…………………………………………………..…..…**5. F. aurita**
Twig terete, rough or woolly hairy. Leaves sessile or with petiole up to 0.7 cm long; apex with an acumen of 3–6.5 cm long. Syconia in pairs or in fascicles of 3–8…..…**44. F. obscura**

59. Syconia peduncled….………………………………....……………………….……….60
Syconia sessile.……………………………………....……………………………..…..62

60. Syconia with lateral bracts……………………………...………………..………...**25. F. gul**
Syconia without lateral bracts……………………….....………………………………….…61

61. Leaves densely velvety hairy below; intercostal venation scalariform. Common in lowland forests..………………………………....………………………………...…..**21. F. fulva**
Leaves not velvety hairy below; intercostal venation reticulate. In hill and montane forests……………………………………………...……………….……..**57. F. setiflora**

62. Indumentum dark brown. Leaves with 2 glands in the axils of basal pair of lateral veins below. Confined to montane forest at Mt. Kinabalu…………………….....**46. F. paramorpha**
Indumentum yellowish. Leaves without glands in the axils of basal pair of lateral veins below. Widely distributed from lowland to montane forests..........................….**4. F. aurata**

63. Leaves glaucous below……………….……………………**24. F. grossularioides** (in part)
Leaves not glaucous below….…………………….………...……….……………………...64

64. Midrib sunken above…………………….….....……………….………...……………65
Midrib raised or flat above…..………………....…………………………….…………………66

65. Leaf margin revolute……………………….……………..……...**65. F. treubii** (in part)
Leaf margin plane..…………………………...………….………………….………...**6. F. beccarii**

66. Syconia on stolons arising from the base of stem or on stout, leafless, branched twigs arising from the base of stem………………………………..……...…….………………………67

Syconia axillary, or borne on stem, on branches behind the leaves, or on finger-like, leafless branches arising from the stem….………………..…..……………………………………...70

67. Leaves with basal pair of lateral veins short and departing from the midrib at a broad angle; base cordate, subcordate or rounded…………………………….……………..…………..………68
Leaves with the basal pair of lateral veins distinct and departing from the midrib at acute angle; base attenuate or cuneate.……………………..……………………………………69

68. Leaves with one gland in each of the axils of basal lateral veins below. Syconia in small globular clusters along hanging unbranched leafless twigs arising from stemand main branches, obconical, 0.5–0.6 cm across…………….............................…....**39. F. minahassae**
Leaves without gland in the axils of basal lateral veins below. Syconia in dense clusters on stout leafless branched twigs arising from the base of stem, pear-shaped, 2.5–3 cm long..……………………………….............…...…….……..............**11. F. cereicarpa**

69. Leaf apex obtuse; margin revolute…..……………..……………..………**33. F. macrostyla** (in part)
Leaf apex acuminate, acumen 1–2.5 cm long; margin plane……………....**62. F. subterranea**

70. Syconia borne on stem and branches or on finger-like, leafless twigs arising from the stem.71
Syconia axillary or borne on twigs behind the leaves……….…..…………………..………74

71. Twig hollow. Syconia obpyramidal..…………..……………..…**43. F. obpyramidata** (in part)
Twig solid. Syconia of other shapes………....………………..………..…………….……72

72. Leaf apex obtuse........…………………………………………………………..……**42. F. nota**
Leaf apex acuminate, acumen 1–3 cm long…………………………………….……….73

73. Leaves silky hairy especially on midrib below; margin entire…..……………..**20. F. francisci**
Leaves not silky hairy; margin lobed towards apex…………………….……**40. F. moderata**

74. Leaves hairy only on the midrib below……………………………..……**48. F. pubinervis**
Leaves hairy all over the lower or both surfaces……..…………………….……………75

75. Indumentum whitish. Very tall trees with smooth whitish bole and tall buttresses…………………………………………………....…………...…**1. F. albipila**
Indumentum brownish or yellowish. Small trees……………………..……………..………76

76. Leaf margin revolute……………………………………....……………………….....77
Leaf margin plane……………………………………….....………………………….....78

77. Syconia with long lateral bracts……………………..……………..**33. F. macrostyla** (in part)
Syconia without lateral bracts……………………...………………...……...**61. F. subfulva**

78. Leaves with hairy glands in the axils of lateral veins………..……………...**2. F. androchaete**
Leaves without hairy glands in the axils of lateral veins…….………………………………79

79. Leaves up to 8 cm wide; lateral veins 4–6 pairs……………………….…..**23. F. glandulifera**

Leaves 7–15.5 cm wide; lateral veins more than 6 pairs……….……………..**53. F. ruficaulis**

80. Stranglers……………………………………………….…..……...…….….…….….…..81
Climbers, creepers, epiphytes, or scandent shrubs……………….…………………………116

81. Midrib sunken above……..……………………………………..…….……….…...…..82
Midrib raised or flat above………....……………………………..………………...……..88

82. Leaves thick-coriaceous, cardboard like; margin revolute…………**70. F. xylophylla** (in part)
Leaves very much thinner; margin plane…………………….………………………….....83

83. Leaf base rounded……..…………………….………………...………………….….............

F. borneensis Kochummen (in part)

(of Borneo)

Gard. Bull. Sing. 50 (1998) 202. Type: *SAN 131862*, Borneo, Sabah, Labuk Sugut district, Telupid (holotype KEP).

Monoecious strangler. Young twigs yellowish, grooved. Stipules ovate or lanceolate, *c.* 1.5 × 0.5 cm, glabrous or hairy. *Leaves coriaceous*, *glabrous*, drying to chocolate-brown; elliptic or oblong, 6.5–10.5 × 1.5–5 cm, *base rounded or cuneate*, *margin entire*, *plane*, apex acute; *midrib sunken above*; lateral veins 4–6 pairs, curving and joining to form looped intramarginal vein, distinct below, invisible above, basal pair reaching about 1/3 the length of the blade; intercostal venation reticulate, visible below, invisible above; petiole 1–2 cm long, glabrous, drying black. *Syconia borne on twigs behind the leaves*, ripening red, *sessile*, oblong or ellipsoid-oblong, 1–1.2 × 0.7 cm, surface rugose with distinct ridges, apex truncate; basal bracts triangular with acute tip, persistent.

Endemic to Borneo; very rare, known only from six collections including the type from Sabah and Sarawak. From Sabah recorded for Mt. Kinabalu area, while in Sarawak it is known from Kapit and Miri (Lambir Hill NP) districts. Lowland to lower montane forests, up to 1300 m altitude, on ultrabasic or organic soils.

Leaf base cuneate….………………………………………………….…..…………….84

84. Petiole appressed hairy……………………..………………………..………………………

F. subgelderi Corner

(resembling *F. gelderi*, a synonym of *F. pellucido-punctata*)

Gard. Bull. Sing. 17 (1960) 386, *l.c.* (1965) 17; Kochummen *l.c.* 157; Anderson *l.c.* 261; Whitmore, Tantra & Sutisna *l.c.* 256; Turner *l.c.* 354; Coode *et al.* (eds.) *l.c.* 218. Type: *SFN 29244*, Singapore (holotype SING).

Large, *monoecious strangler*. Twigs slender, irregularly ridged, appressed hairy. Stipules lanceolate, 1.2–1.5 cm long, silky hairy outside, caducous. *Leaves coriaceous*, *glabrous*; elliptic to narrowly obovate, 9–14 × 2.5–4.5 cm; *base cuneate*, *margin entire*, *plane*, apex acute; *midrib sunken above*; lateral veins 5 pairs, with shorter veins in between, raised below, faint above, looping and joining near the leaf margin, basal pair reaching up to 1/2 the length of the blade; intercostal venation reticulate, faintly visible below, invisible above; *petiole* 1.5–2.5 cm long, *appressed hairy*, channelled on the adaxial side. *Syconia axillary*, *sessile*, *ellipsoid to oblong*, 1–1.5 × 0.9–1.1 cm; surface rugose on drying, apex flat to slightly depressed; basal bracts prominent, persistent; lateral bracts absent.

Peninsular Malaysia and Borneo. Widely distributed in Sabah, very rare in Sarawak. In lowland mixed dipterocarp forest. Also in Brunei and Kalimantan.

Petiole glabrous…........……………….……….....…………………………….……………85

85. Syconia 1–1.2 cm diameter…………………....……………..……………………………………

F. pisocarpa Blume

(Greek, *pison* = pea, *karpos* = fruit; the pea-shaped syconia)

Bijdr. Fl. Ned. Ind. (1825) 454; King *l.c.* (1887) 48; Ridley *l.c.* (1924) 336; Corner *l.c.* 17 (1960) 394, *l.c.* (1965) 20; Kochummen *l.c.* 153; Anderson *l.c.* 260; Whitmore, Tantra & Sutisna *l.c.* 252; Turner *l.c.* 353; Coode *et al.* (eds.) *l.c.* 217. Type: *Blume s.n.*, Java, Mt. Gede (holotype L?). Synonyms**:** *Urostigma pisocarpum* (Blume) Miq., Fl. Ind.-Bat. 1, 1 (1859) 344; *U. cycloneuron* Miq., Fl. Ind. Bat., Suppl. (1861) 438; *F. pseudorubra* Miq. *l.c.* (1867) 264; *F. cycloneura* (Miq.) King *l.c.* (1887) 31; *F. microstoma* Wall. *ex* King *l.c.* (1887) 38.

Monoecious strangler. *Twigs yellowish,* angled. Stipules lanceolate, *c.* 1 cm long, hairy, caducous. Leaves *coriaceous*, *glabrous*; obovate or elliptic, 9–16 × 3–8.8 cm, *base cuneate*, *margin entire*, *plane,* apex obtuse or acute; *midrib sunken above*; lateral veins 4–6 pairs, looping and joining near the leaf margin, raised below, visible above, basal pair reaching more than 1/2 the length of the blade; intercostal venation reticulate, visible on both surfaces; *petiole* 0.7–2 cm long, drying black, *glabrous*. *Syconia borne in pairs on twigs behind the leaves*, *sessile*, subglobose, *1–1.2 cm diameter*, *apex umbonate with tiny perforation*; basal bracts persistent; lateral bracts absent.

Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. Common in Sabah, rare in Sarawak. In lowland forest by streams to hill forest up to 1000 m altitude. Also in Kalimantan.

Syconia 0.4–1 cm diameter………………………..……...…………..…………………...86

86. Syconia oblong or ellipsoid-oblong…………….……………….………..**F. borneensis** (in part)

Syconia broadly ellipsoid or subglobose…..………...……………..……………….….………..87

87. Perianth of male flower consists of 3 tepals. Syconia in axillary pairs, ellipsoid-globose, apex umbonate, rarely depressed……………………...................…..……………………………………

F. sumatrana (Miq.) Miq. (in part)

(of Sumatra)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 263; King *l.c.* (1887) 40; Backer & Bakhuizen *f. l.c.* 35; Corner *l.c.* (1965) 18; Kochummen *l.c.* 158; Anderson *l.c.* 261; Whitmore, Tantra & Sutisna *l.c.* 256; Turner *l.c.* 354. Basionym: *Urostigma sumatranum* Miq., Pl. Jungh. (1851) 49. Type: *Junghuhn s.n.* (= *RHL Sheet No. 9081881575*), Sumatra, Tobing (holotype L). Synonyms: *U. zollingeriana* Miq. *in* Zollinger, Syst. Verz. 2 (1854) 91; *U. monadenum* Miq. *l.c.* (1861) 437; *F. zollingeriana* (Miq.) Miq. *l.c.* (1867) 264; *F. pseudocamptophylla* Valeton *in* Koorders & Valeton, Bijdr. Booms. Java 11 (1906) 105.

Monoecious strangler. Twigs pale white to pale brown, grooved. Stipules oblong to lanceolate, acute, up to 1.5 cm long, usually glabrous, caducous. *Leaves thick-coriaceous*, *glabrous*; elliptic or oblong, 4.5–10 × 2–6 cm, *base cuneate* to rounded, *margin entire*, *plane*, apex acute; *midrib sunken above* (flat in var. *subsumatrana*); lateral veins 4–5 pairs, raised below, very faint above, basal pair reaching more than 1/2 the length of the blade; intercostal venation reticulate, visible below, invisible above; *petiole glabrous*, 0.7–1.5 cm long. *Syconia axillary*, *in pairs*, *sessile*, *broadly ellipsoid*, *0.4–0.9 cm diameter*, *apex umbonate*, *rarely depressed*; basal bracts prominent, persistent; lateral bracts absent. *Perianth of male flowers consists of 3 tepals*.

Burma, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, and Sumbawa. Uncommon in Sabah and Sarawak. In lowland and hill forests, up to 800 m altitude. Also in Kalimantan.

Three varieties are recognised in Sabah and Sarawak, viz. var. *sumatrana*, var. *subsumatrana* (Gagnep.) Corner and var. *microcyse* Corner (*cf.* Corner *l.c.* 17 (1960) 390).

Perianth of male flowers consists of 2 tepals. Syconia borne on twigs behind the leaves, subglobose, apex rounded……………………...…………………………………….....................

F. dulitensis Kochummen

(of Dulit Range, Sarawak)

Gard. Bull. Sing. 50 (1998) 205. Type: *Dayang Awa & Yii S. 46743*, Borneo, Sarawak, Dulit Range, Belaga district (holotype KEP; isotype SAR).

Monoecious strangler. Twigs dark brown. Stipules oblong, acute, *c.* 1 cm long, glabrous, caducous. *Leaves coriaceous*, *glabrous*; elliptic to oblong, 4–6.5 × 2–3.5 cm, *base broadly cuneate*, *margin entire*, *plane*, apex acute; *midrib sunken above*; lateral veins 3–4 pairs, raised below, invisible above, basal pair reaching more than 1/2 the length of the blade; intercostal venation reticulate, visible below, invisible above; *petiole glabrous*, 0.5–1 cm long. *Syconia borne on twigs behind the leaves*, yellowish when ripe, *subglobose*, *c. 0.8 cm diameter*, *apex rounded*, *sessile*, with 3 large basal lanceolate bracts. *Perianth of male flowers consists of 2 tepals*.

Endemic to Borneo; very rare, known only by the type from Dulit Range, Belaga district, Sarawak; in hill forest, up to 800 m altitude.

88. Leaf margin revolute..…………………….……………………....………………..……...89

Leaf margin plane……………………………...…………………...………………….…..93

89. Leaves drying blackish; apex obtuse or rounded; lateral veins invisible. Confined to peatswamp forest...……………………………………….....……......……...……………...

F. tristaniifolia Corner

(with leaves resembling those of *Tristania*, Myrtaceae)

Gard. Bull. Sing. 17 (1960) 397, *l.c.* (1965) 22; Kochummen *l.c.* 159; Anderson *l.c.* 261; Whitmore, Tantra & Sutisna *l.c.* 258; Turner *l.c.* 355. Type: *SFN 36698*, Peninsular Malaysia, Johore, Pontian (holotype SING).

Monoecious strangler. Stipules up to 2.2 cm long, glabrous. *Leaves thick-coriaceous*, *drying blackish*, *glabrous*; obovate, 5–8.5 × 1.5–5 cm, *base cuneate*, *margin entire*, *revolute*, *apex rounded*; *midrib flat above*; *lateral veins 7–9 pairs*, *almost invisible*, basal pair reaching to about 1/3 the length of the blade; *petiole glabrous*, 0.5–1.2 cm long. *Syconia axillary*, *in pairs*, *sessile*; *subglobose*, *0.8–1 cm across*; basal bracts covering 1/3–1/2 of the receptacle surface; lateral bracts absent.

Sumatra, Peninsular Malaysia and Borneo. In Borneo rare, recorded in Sarawak only from peatswamp forest.

Leaves drying not blackish; apex acute or acuminate; lateral veins visible…………….…....90

90. Leaves with 1–2 glands in the axils of basal pairs of lateral veins below. Syconia in clusters on the twigs behind the leaves………………...………...……………………………………...

F. uniglandulosa Wall. *ex* Miq.

(Latin, *uni-* = one, *glandulosus* = gland-bearing; the basal pair of lateral veins)

In Hooker, Lond. J. Bot. 7 (1848) 277; Corner *l.c.* (1965) 79; Kochummen *l.c.* 160; Anderson *l.c.* 261; Whitmore, Tantra & Sutisna *l.c.* 258; Turner *l.c.* 355; Coode *et al.* (eds.) *l.c.* 219. Type: *Sine coll., s.n.* (= *RHL Sheet No. 9081881706*), Penang (Prince of Wales Island) (K, L). Synonyms: *F. subsubulata* Miq. *l.c.* (1867) 225; *F. uniglandulosa* Wall. *ex* Miq. var. *latior* Miq. *l.c.* (1867) 277; *F. uniglandulosa* Wall. *ex* Miq. var. *parvifolia* Miq. *l.c.* (1867) 277, *syn. nov.*; *F. copelandii* C.B. Robinson, Philip. J. Sc. 3 (1908) Bot. 176.

Dioecious strangler. *Leaves* thin- to thick-coriaceous, *glabrous*, *drying greenish yellow*; elliptic or oblong, 5–21 × 2.5–10.5 cm, *base cuneate*, *margin entire*, *revolute*, *apex acuminate*, *acumen 1–2 cm long*; *midrib raised above*; *lateral veins* 4–7 pairs, with shorter veins in between, forming a wide angle with the midrib, *with a dark brown gland in the axil of each basal lateral vein below*, looping and joining to form a distinct intramarginal vein, *distinctly raised below*, *visible above*; intercostal venation finely reticulate-areolate, often distinctly visible below, invisible above; petiole 0.7–1.5 cm long. *Syconia in clusters on the twigs behind the leaves*, glabrous, oblong to subglobose, 0.5–0.7 cm diameter, ostiole often sunken, *base tapered into slender stalk 0.3–0.5 cm long*.

Burma, Thailand, Sumatra, Peninsular Malaysia, Borneo, Sulawesi, and the Philippines. Very common in Sabah and Sarawak. In lowland and hill forests, including limestone habitat, up to 900 m altitude. Also in Brunei and Kalimantan.

Leaves without glands in the axils of basal pairs of lateral veins below. Syconia in pairs, axillary or borne on twigs behind the leaves………………...………………...…………..91

91. Lateral veins 4–6 pairs; leaf margin thickened……………………………………….……………...

F. sundaica Blume

(of the Sundalands)

Bijdr. Fl. Ned. Ind. (1825) 450; Backer & Bakhuizen *f. l.c.* 35; Corner *l.c.* (1965) 18; Kochummen *l.c.* 158; Anderson *l.c.* 261; Whitmore, Tantra & Sutisna *l.c.* 256; Turner *l.c.* 354; Coode *et al.* (eds.) *l.c.* 218; Argent *et al.* (eds.) *l.c.* 439. Type: *Blume s.n.* (= *RHL Sheet No. 908188554*), Java, Tjiandjur (holotype L). Synonyms: *F. rubescens* Blume *l.c.* 453; *F. indica* L. var. *sundaica* (Blume) Miq. *l.c.* (1851) 50; *Urostigma pyrifolium* Miq. *l.c.* (1859) 338; *U. sundaicum* (Blume) Miq. *l.c.* (1859) 343; *U. rubescens* (Blume) Miq. *l.c.* (1859) 338; *U. pseudorubrum* Miq. *l.c.* (1859) 343; *F. pyrifolia* (Miq.) Boerl., Handl. Fl. Ned. Ind. 3 (1900) 369.

Monoecious strangler. Twigs grey-brown to dark brown, grooved. Stipules lanceolate, 2.5 cm long, velvety hairy outside or glabrous, caducous. *Leaves glabrous*; elliptic, oblong or narrowly obovate, 6.5–21 × 2.8–9 cm, *base cuneate*, *margin thickened*, *entire or lobed*, *revolute*, *apex acute*; *midrib flat* or sunken (var. *impressicostata*) above; *lateral veins 4–6 pairs*, *visible on both surfaces*, curving and joining near leaf margin, with 2–3 shorter veins in between, basal veins reaching about 1/2 or more the length of the blade, *without glands in the axils below*; intercostal venation reticulate, visible below, faint above; petiole 1.5–3 cm long, channelled on the adaxial side. *Syconia in pairs*, *axillary*, *sessile*, orange-yellow when ripe, oblong, 1.5–2 × 1.2–2 cm, strongly irregularly wrinkled on drying, apex disc-like; basal bracts large with round apex, persistent.

Assam, Burma, Indo-China, Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. Widely distributed in Sabah and Sarawak, from lowland to lower montane forests, up to 1200 m altitude. Also in Brunei and Kalimantan.

Three varieties are recognised in Sabah and Sarawak, viz. var. *sundaica*, var. *impressicostata* Kochummen, and var. *beccariana* (King) Corner (*cf.* Corner *l.c.* 1965, and Kochummen *l.c.* (1998) 217).

Lateral veins 6–10 pairs; leaf margin not thickened………………………………….…………...92

92. Syconia subglobose to globose, 1.2–1.5 × 1–1.5 cm…………………………………….………..

F. callophylla Blume

(Greek, *kallos* = beautiful, *phullon* = leaf; with beautiful leaves)

Bijdr. Fl. Ned. Ind. (1825) 445; Backer & Bakhuizen *f. l.c.* 24; Corner *l.c.* (1965) 22; Kochummen *l.c.* 142; Whitmore, Tantra & Sutisna *l.c.* 242; Turner *l.c.* 349; Coode *et al.* (eds.) *l.c.* 212. Type: *Blume s.n.* (= *RHL Sheet No. 9081861220*), Java, Tjiandjur, Mt. “Sallashie” (holotype L). Synonyms: *F. tylophylla* Hassk., Cat. Hort. Bog. (1844) 75; *Urostigma clusioides* Miq. *l.c.* (1847) 579; *Artocarpus venenosa* Zoll. & Moritzi var. *tylophylla* (Hassk.) Miq. *l.c.* (1854) 89; *U. callophyllum* (Blume) Miq. *l.c.* (1859) 349; *F. clusioides* (Miq.) Miq. *l.c.* (1867) 286.

Monoecious strangler. Twigs grey-brown, flat and grooved, glabrous. Stipules lanceolate, acute, 2.5–3 cm long, glabrous. *Leaves glabrous*, *drying not blackish*; elliptic to oblong 12.5–24 × 5–9.5 cm, *base cuneate*, *margin faintly revolute and lobed*, *apex acute*; *midrib raised above*; *lateral veins 8–10 pairs*, joining near the leaf margin to form distinct intramarginal vein, with 2–3 shorter veins in between, *distinct below*, *faint above*, *basal pair without glands in the axils below*; intercostal venation faint; petiole 2–4.5 cm long. *Syconia in pairs*, *borne on twigs behind the leaves*, *sessile*, *subglobose to globose*, *1.2–1.5 × 1–1.5 cm*, apex umbonate; surface rugose, with persistent large basal bracts.

Indo-China, Hong Kong, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, and Sulawesi. Very rare in Sabah, known by 2 collections, *SAN A 67* and *SAN 23615*, from Sandakan district and Kinabatangan district, respectively; not yet reported for Sarawak. Also in Brunei and Kalimantan.

Syconia oblong, up to 1 × 0.6 cm……………......……………………….………………...

F. chewii Kochummen

(W.L. Chew, 1932–, formerly plant taxonomist, Singapore Botanic Gardens)

Gard. Bull. Sing. 50 (1998) 203. Type: *RSNB 1972*, Borneo, Sabah, Mt. Kinabalu (holotype SAN; isotype SING).

Monoecious strangler. Twigs greyish yellow, finely ridged. *Stipules* ovate-lanceolate, acute, 1.5–1.7 cm long, *hairy outside*, caducous. *Leaves thick-coriaceous*, *glabrous*, *drying not blackish*, shiny above; elliptic or oblong, (2.7–)6–11 × (1.5–)3.5–5.5 cm, *base rounded or broadly cuneate*, *margin entire*, *revolute*, *apex acute*; *midrib raised above* with distinct groove in the middle; *lateral veins 6–8 pairs*, with shorter veins in between, curving and joining near the leaf margin, *faintly visible on both surfaces*, basal veins reaching about 1/2 the length of the blade, *without glands in the axils below*; intercostal venation reticulate, faint below, invisible above; petiole 0.7–1.7 cm long, drying black. *Syconia solitary on the twigs behind the leaves*, *sessile*, *oblong*, *c. 1 × 0.6 cm*, *apex truncate* with disc-like apical bracts; surface irregularly wrinkled; basal bracts persistent, with rounded apex.

Endemic to Borneo. Very rare, known from the type only from Mt. Kinabalu in Sabah, at about 1300 m altitude. This species is near to *F. sumatrana* but the syconia are oblong.

93. Lateral veins numerous, closely spaced, parallel, running straight towards the leaf margin...94
Lateral veins fewer, distantly spaced, curved towards the leaf margin……...……………....95

94. Leaves 4–8 × 1.8–3.8 cm. Syconia globose; basal bracts tiny, concealed by the syconia. Branches drooping.………..……………….................……………**7. F. benjamina** (in part)
Leaves 10–15 × 3.5–8.5 cm. Syconia subglobose; basal bracts prominent. Branches not drooping……………………………………..……………....………..……………………….

F. stricta (Miq.) Miq.

(Latin, *strictus* = drawn close together; probably referring to the syconia)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 288; Corner *l.c.* (1965) 21; Whitmore, Tantra & Sutisna *l.c.* 255; Turner *l.c.* 354. Basionym: *Urostigma strictum* Miq. *l.c.* (1851) 50. Type: *Junghuhn 10* (= *RHL Sheet No. 9081881495*), Java (holotype L).

Monoecious strangler. *Twigs crooked*, *not drooping*, brown, 0.2–0.3 cm thick. *Leaves glabrous*, *drying to straw colour*; elliptic, *10–15 × 3.5–8.5 cm*, *base cuneate*, *margin entire, plane,* apex acute; *midrib flat above*; *lateral veins numerous*, *close and parallel*, very faint on both surfaces, with 2–3 shorter veins in between; *intercostal venation invisible*; petiole 1–1.2 cm long, channelled on the adaxial side, *drying yellowish*. *Syconia on twigs behind the leaves, sessile, subglobose*, 1–1.2 cm diameter, irregularly wrinkled on drying, apex umbonate; *basal bracts ovate, prominent*, persistent.

Andaman Islands, S China, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, and the Philippines. Very rare in Sabah and Sarawak; in lowland forest. Not known in Brunei.

95. Petiole up to 2 cm long……………………………………………………………………96
Petiole more than 2 cm long…………………………………………………………....100

96. Apex of leaf obtuse……………………………………………………………………
F. binnendykii (Miq.) Miq. (in part)

(S. Binnendijk, 1821–1883, sometime adjunct horticulturist, Bogor Botanic Gardens, Indonesia)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 288; King *l.c.* (1887) 41; Merrill *l.c.* (1921) 221; Ridley *l.c.* (1924) 336; Backer & Bakhuizen *f. l.c.* 35; Corner *l.c.* (1965) 20; Kochummen *l.c.* 141; Anderson *l.c.* 257; Whitmore, Tantra & Sutisna *l.c.* 241; Turner *l.c.* 349. Basionym: *Urostigma binnendykii* Miq. *l.c.* (1859) 341. Type: unknown. Synonyms: *U. peracutum* Miq. *l.c.* (1859) 343; *F. peracuta* (Miq.) Miq. *l.c.* (1867) 306.

Monoecious strangler, *all parts glabrous*. Twigs grey-brown, angled and ridged. Stipules lanceolate, acute, *c.* 1.2 cm long, persistent. Leaves thin- to thick-coriaceous, drying reddish brown or greenish yellow; elliptic or oblong, 4–11.5 × 2–5.5 cm, *base rounded or cuneate, margin entire, plane, apex obtuse*; *midrib raised above*; *lateral veins 4–5 pairs, distantly spaced, curved, arching and joining near the leaf margin*, faint on both surfaces; intercostal venation reticulate, visible below; *petiole 0.7–1 cm long*, drying blackish, channelled on the adaxial side. *Syconia in pairs on twigs behind the leaves, sessile*, depressed globose, *c.* 0.5 cm diameter, *with perforated apex*; basal bracts small, persistent.

Peninsular Malaysia, Java and Borneo. Rare in Sabah and Sarawak. In lowland to hill forests, up to 1000 m altitude. Not known in Brunei.

Three varieties are recognised in Sabah and Sarawak, viz. var. *binnendykii*, var. *coriacea* Corner, and var. *latifolia* Corner (*cf.* Corner *l.c.* (1965) 20).

Apex of leaf acute……………………………………………………………………...97

97. Leaf blade asymmetric………………………………………………**64. F. tinctoria** (in part)
Leaf blade symmetric……………………………………………………………………...98

98. Syconia depressed globose with perforated apex…………………**F. binnendykii** (in part)
Syconia globose, ellipsoid, or subglobose, apex umbonate, flat to convex, without apical perforation……………………………………………………………………...99

99. Twigs reddish brown. Basal bracts of syconia small……………………………………
F. delosyce Corner

(Greek, *delos* = striking, *syce* = fig-tree)

Gard. Bull. Sing. 17 (1960) 391, *l.c.* (1965) 19; Kochummen *l.c.* 144; Anderson *l.c.* 258; Whitmore, Tantra & Sutisna *l.c.* 243; Coode *et al.* (eds.) *l.c.* 213; Turner *l.c.* 349. Type: *SFN 28607*, Peninsular Malaysia, Johore (holotype SING). Synonym: *F. delosyce* Corner var. *obtusa* Corner *l.c.* 17 (1960) 391. Type: *Kostermans 5681*, Borneo, E Kutei (BO), *syn. nov.*

Monoecious strangler. *Twigs reddish brown*, slender, *c.* 0.2 cm thick. Stipules glabrous, ovate to lanceolate with caudate tip *c.* 1 cm long. *Leaves glabrous*; elliptic, oblong, or narrowly obovate, 3.5–5 × 1.5–2.8 cm, *base symmetric*, *cuneate*, *margin entire*, *plane*, *apex acute*, rarely obtuse or rounded; *midrib flat above*; *lateral veins 4–5 pairs*, *distantly spaced*, *curved*, looping and joining near the leaf margin, very faint below, invisible above, basal pair reaching up to 1/2 of the blade; intercostal venation very faint below, invisible above; *petiole 0.5–0.8 cm long*. *Syconia borne on the twigs behind the leaves*, *sessile*, *ellipsoid or subglobose*, *c.* 0.5 cm diameter, ripening orange-yellow, *apex umbonate*; *basal bracts small*, acute, persistent.

Peninsular Malaysia and Borneo. Common in Sabah, not yet recorded for Sarawak. In lowland forest including swamp forest. Also in Brunei and Kalimantan.

Twigs pale whitish. Basal bracts of syconia large…………..…...…....**F. sumatrana** (in part)

100. Plants with abundant free hanging aerial roots…………………..………….…………101
Plants without or with a few free hanging aerial roots…………………………...………..103

101. Lateral veins steeply ascending. Syconia globose……………….....**37. F. microcarpa** (in part)
Lateral veins forming a broad angle with the midrib. Syconia oblong or globose………..102

102. Syconia oblong, sessile........……………………………...………...…………………...

F. drupacea Thunb.

(Latin, *drupaceus* = drupe-like; the syconia)

Diss. Fic. (1786) 6; Miquel *l.c.* (1867) 286; King *l.c.* (1887) 21; Corner *l.c.* 17 (1960) 380, *l.c.* (1965) 13; Turner *l.c.* 350. Type: *Thunberg s.n.*, no locality (UPS). Synonyms: *F. chrysocoma* Blume *l.c.* 443; *F. pilosa* Reinw. *ex* Blume *l.c.* 446; *F. payapa* Blanco, Fl. Filip. (1837) 683; *F. vidaliana* Warb. *in* Perkin, Fragm. Fl. Philip. 3 (1905) 197.

Large, *monoecious strangler*, *with abundant free hanging aerial roots*. Stipules reddish hairy. *Leaves* at first reddish brown hairy, *becoming completely glabrous later*; elliptic, oblong-elliptic or obovate, 8–26 × 3–13 cm, *base cuneate to rounded*, *margin entire*, *plane*, apex acute; *midrib raised above*; *lateral veins 7–10 pairs*, *distantly spaced*, *curved*, *forming a broad angle with the midrib*, with few shorter veins in between, raised on both surfaces, basal pair short; intercostal venation subscalariform, visible below, invisible above; *petiole 1–4.5 cm long*. *Syconia axillary*, *sessile*, *oblong*, 1.5–3.5 × 1.2–2 cm, ripening orange to red; apex disc-like; basal bracts small, concealed by the syconia.

Sri Lanka, S India, Burma, Indo-China, Thailand, Malesia, Solomon Islands, and Queensland. Very rare in Sabah and Sarawak. In lowland forest by streams. Not known in Brunei and Kalimantan.

Syconia globose, peduncled.......……………………....……………………..……………

Ficus glaberrima Blume var. **bracteata** Corner

(Latin, *glaberrimus* = completely without hairs; the leaves; *bracteatus* = with bracts, the syconia)

Gard. Bull. Sing. 17 (1960) 388, *l.c.* (1965) 17. Type: *Hoogland 3748*, New Guinea, Garara (holotype LAE). Synonyms: *F. travancorica* King *l.c.* (1887) 28; *F. adamii* Elmer, Leafl. Philip. Bot. 4 (1911) 1258; *F. villamilii* Merr. *ex* Sata, Monogr. (1944) 183.

Monoecious strangler with abundant free hanging aerial roots. *Leaves glabrous*; elliptic or ovate-elliptic, 6–17 × 2–6 cm, *base cuneate*, *margin entire*, *plane*, apex acute; *midrib raised above*; *lateral veins 7–15 pairs*, *distantly spaced*, *curved*, *forming a broad angle with the midrib*, with shorter intermediate veins; intercostal venation invisible; *petiole*

1.2–5 cm long. *Syconia often solitary*, ripening dull orange-yellow to purple-black, *globose*, 0.7–1 cm diameter, apex umbonate; *peduncle 0.3–1 cm long*; basal bracts 3, with distinct round apices.

India, Borneo, the Philippines, and New Guinea. Very rare in Borneo, known only by a single collection, *Purseglove 5183*, from Sg. Mayeng, Tatau district, Sarawak.

103. Basal pair of lateral veins distinct and departing at an acute angle from the midrib……………………………………………….....…………………………...……104

Basal pair of lateral veins not distinct and departing at a wide angle from the midrib…………………………………………….....……………………………..114

104. Syconia covered with irritant hairs……………………...……………………………………..

F. cucurbitina King

(Latin, *cucurbitinus* = resembling pumpkin or gourd; the syconia)

Ann. Roy. Bot. Gard. Cal. 1, 1 (1887) 22; Merrill *l.c.* (1921) 222; Corner *l.c.* (1965) 14; Kochummen *l.c.* 144; Whitmore, Tantra & Sutisna *l.c.* 243; Turner *l.c.* 349. Type: *Beccari PB 3436*, Borneo, Sarawak (FI). Synonym: *F. elliptifolia* Merr., Philip. J. Sc. 18 (1921) 55.

Monoecious strangler, *without free hanging aerial roots*. Twigs reddish brown, strongly wrinkled on drying. Stipules lanceolate, reddish hairy. *Leaves glabrous*; oblong to narrowly obovate, 11–18.5 × 5–9 cm, *base rounded*, *margin entire*, *plane*, apex acute; *midrib flat above*; lateral veins 8–14 pairs, *distantly spaced*, *curved*, faintly looping near the leaf margin, with short intermediate veins, distinct on both surfaces, *basal pair distinct*, *departing at an acute angle from the midrib*; intercostal venation reticulate, visible on both surfaces; *petiole 1.5–3 cm long*, drying black. *Syconia borne on twigs behind the leaves*, *sessile*, ripening yellow, oblong, 3.5–4.5 × 2–3 cm, *with truncate apex*, *surface irregularly wrinkled and covered with long irritant hairs.*

Peninsular Malaysia, Borneo and the Philippines. Rare in Sabah and Sarawak. Not known in Brunei. In lowland and hill mixed dipterocarp forests.

Syconia not covered with irritant hairs……………………….…...………..……………105

105. Syconia sessile……………………………………...……….…....………………..106

Syconia with distinct peduncles………………………...…………....……….……...111

106. Syconia 2–3 cm diameter..…………………………………………...………………....107

Syconia 0.5–1.8 cm diameter……………………………………...…………………108

107. Leaves thick-coriaceous, apex obtuse. Syconia ellipsoid or oblong………...………………...

F. stupenda Miq.

(Latin, *stupendus* = wonderful, marvellous; probably referring to the syconia)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 286; Backer & Bakhuizen *f. l.c.* 31*;* Corner *l.c.* (1965) 15; Kochummen *l.c.* 157; Anderson *l.c.* 261; Whitmore, Tantra & Sutisna *l.c.* 255. Type: *Zollinger s.n.* (= *RHL Sheet No. 9081881488*), Java, Mt. Salak (holotype L). Synonym: *Urostigma giganteum* Miq. *l.c.* (1854) 90; *F. stupenda* Miq. var. *minor* Corner *l.c.* 17 (1960) 384. Type: *Goodenough 3399*, Singapore (SING), *syn. nov.*

Monoecious strangler, *without free hanging aerial roots*. Twigs grey-brown, strongly ridged, with prominent leaf scars. Stipules caducous, ovate, *c.* 1.3 cm long, *finely hairy*. *Leaves thick-coriaceous*, *glabrous*; elliptic or oblong, 13.5–25.5 × 7–14 cm, *base broadly cuneate to rounded*, *margin entire*, *plane*, *apex obtuse*; *midrib raised above*;

lateral veins 7–9 pairs, *distantly spaced*, *curved*, raised below, visible above, joining near the leaf margin, *basal pair distinct*, *departing from the midrib at an acute angle*, *reaching up to 1/3 the length of the blade*; intercostal venation finely reticulate, faint on both surfaces; *petiole 2.7–3.5 cm long*, channelled on the adaxial side. *Syconia borne on twigs behind the leaves*, *sessile*, *ellipsoid or oblong*, *2.5–5 × 1.5–3 cm*, surface rugose, *not covered by irritant hairs*, apex umbonate; basal bracts persistent.

Sumatra, Peninsular Malaysia, Java, and Borneo. Rare in Sabah and Sarawak. Not known in Brunei. In lowland to lower montane forests, up to 1500 m altitude.

Leaves thinner, apex acute. Syconia ovoid.……………………….………..……….…………...

F. annulata Blume (in part)

(Latin, *annulatus* = marked with ring-like swelling; the syconia)

Bijdr. Fl. Ned. Ind. (1825) 448; King *l.c.* (1887) 25; Merrill *l.c.* (1921) 220; Ridley *l.c.* (1924) 33; Burkill *l.c.* 1020; Backer & Bakhuizen *f. l.c.* 31; Corner *l.c.* (1965) 12, *l.c.* (1988) 538; Kochummen *l.c.* 140; Anderson *l.c.* 256; Whitmore, Tantra & Sutisna *l.c.* 240; Turner *l.c.* 348. Type: *Blume s.n.* (= *RHL Sheet No. 908186925*), Java, Mt. Salak (holotype L). Synonyms: *F. flavescens* Blume *l.c.* 449; *F. valida* Blume *l.c.* 449; *Urostigma annulatum* (Blume) Miq. *l.c.* (1854) 90; *U. biverrucellum* Miq. *l.c.* (1860) 436; *F. annulata* (Blume) Miq. var. *flavescens* (Blume) King *l.c.* (1887) 26; *F. annulata* (Blume) Miq. var. *valida* (Blume) King *l.c.* (1887) 26; *F. balabacensis* Quisumbing, Philip. J. Sc. 41 (1930) 316.

Monoecious strangler, *without free hanging aerial roots*. Twigs grey, ridged. *Stipules* lanceolate, *1.5–3.5 cm long*, acute, glabrous or velvety hairy outside, caducous or persistent. *Leaves thin-coriaceous*, drying chocolate-brown, *glabrous* or hairy below; elliptic, 10–32 × 3–11 cm, *base wedge-shaped, margin entire*, *plane*, *apex acute*; *midrib raised above*; *lateral veins 7–16 pairs*, *distantly spaced*, with short intermediate veins, *curved*, *looping and joining near the leaf margin*, faint above, distinct below, *basal pair distinct*, *departing at an acute angle from the midrib*; intercostal venation reticulate, visible below, very faint above; *petiole 1–6 cm long*, drying black. *Syconia borne on twigs behind the leaves*, golden yellow, *ovoid* or ellipsoid, *2.5–3.5 × 2–3 cm*, apex umbonate, surface irregularly rugose on drying, *not covered by irritant hairs*; *sessile* or with peduncle up to 2 cm long, *with ring-like swelling towards the apex*; basal bracts 3, tiny, persistent.

Burma, Indo-China, Yunan, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, and the Philippines. Common in Sabah, rare in Sarawak. Not known in Brunei. Lowland and hill forests, up to 600 m altitude.

108. Syconia oblong, apex perforated. Petiole 1–3 cm long……………….……...…………………..

F. pellucido-punctata Griff.

(Latin, *pellucidus* = translucent but not hyaline, *punctatus* = dotted; the syconia)

Notula 4 (1854) 394; Corner *l.c.* (1965) 20; Kochummen *l.c.* 153; Anderson *l.c.* 260; Whitmore, Tantra & Sutisna *l.c.* 252; Turner *l.c.* 352; Coode *et al.* (eds.) *l.c.* 216. Type: unknown. Synonyms: *F. gelderi* Miq. *l.c.* (1867) 216; *F. indica* L. var. *gelderi* (Miq.) King *l.c.* (1887) 39; F. *everettii* Elmer, Leafl. Philip. Bot. 2 (1908) 538.

Monoecious strangler, *without free hanging aerial roots*. Twigs grey-brown, grooved. Stipules lanceolate, *c.* 1.5 cm long, softly hairy outside, caducous. *Leaves glabrous*; oblong to elliptic, 5.5–17 × 3.5–5.8 cm, *base cuneate*, *margin entire, plane*, apex acute; *midrib flat above*; *lateral veins 5–7 pairs*, *distantly spaced*, with 3–4 short intermediate veins, faintly raised below, faint to invisible above, *curved*, *looping and joining near the leaf margin*, *basal pair distinct and departing at an acute angle from the midrib*; intercostal venation invisible; *petiole 1–3 cm long*. *Syconia axillary*, *oblong*, *1–1.5 ×*

0.5–0.8 cm, sessile; surface strongly wrinkled on drying, *not covered by irritant hairs*; basal bracts persistent; *apex with small aperture*.

Assam, Indo-China, Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. Widely distributed in Sabah, rare in Sarawak; in lowland mixed dipterocarp forest. Also in Brunei and Kalimantan.

Syconia globose, apex not perforated. Petiole 2.5–6 cm long……………………………..109

109. Syconia up to 0.7 cm diameter……………………………………………………………

F. subtecta Corner

(Latin, *sub-* = somewhat, *tectus* = hidden or concealed; the syconia somewhat hidden by the basal bracts)

Gard. Bull. Sing. 17 (1960) 386, *l.c.* (1965) 16; Kochummen *l.c.* 158; Turner *l.c.* 354. Basionym: *F. procera* Reinw. *ex* Blume (1825), *non* Salisb. 1796. Type: *Blume s.n.* (= *RHL Sheet No. 9081881391*), Java (holotype L). Synonym: *Urostigma procerum* (Blume) Miq. *l.c.* (1859) 336.

Monoecious strangler, without free hanging aerial roots. Twigs dark brown, strongly rugose. Stipules lanceolate, up to 2.5 cm long, appressed hairy outside, caducous. *Leaves glabrous*; elliptic or oblong, 7–21.5 × 3.5–8.5 cm, *base broadly cuneate, margin entire, plane*, apex acute; *midrib flat above*; *lateral veins 5–7 pairs, distantly spaced, curved*, with many short intermediate veins, looping and joining near the leaf margin, visible on both surfaces, *basal pair reaching 1/3 the length of the blade, departing from the midrib at an acute angle*; intercostal venation reticulate, visible on both surfaces; *petiole 2.5–3 cm long*, channelled on the adaxial side. *Syconia axillary*, *sessile*, *globose*, *c. 0.7 cm diameter*; surface rugose on drying, *not covered by irritant hairs*; *apex umbonate*, *not perforated*; *basal bracts large*, *persistent.*

Indo-China, Sumatra, Peninsular Malaysia, and Borneo. Widely distributed in Sabah, rare in Sarawak. Not known in Brunei and Kalimantan. In lowland to lower montane forests, up to 1800 m altitude.

Syconia more than 1 cm diameter…………………………………………………………...110

110. Basal bracts enclosing 3/4 of the syconium……………………………………………

F. involucrata Blume

(Latin, *involucratus* = having an involucre or ring of bracts around the base; the syconia)

Bijdr. Fl. Ned. Ind. (1825) 447; King *l.c.* (1887) 34; Backer & Bakhuizen *f. l.c.* 34; Corner *l.c.* (1965) 18. Type: *Blume s.n.*, Java, Mt. Salak (L?). Synonyms: *Urostigma involucratum* (Blume) Miq. *l.c.* (1859) 334; *F. macrocalyx* Miq. *l.c.* (1867) 217.

Monoecious strangler, *without free hanging aerial roots*. Twigs *c.* 0.7 cm thick, grey-brown, strongly ridged. Stipules lanceolate, acute, 1.5–2.5 cm long, glabrous, caducous. *Leaves glabrous*; oblong to narrowly obovate, 14.5–20 × 4–7 cm, *base cuneate*, *margin entire*, *plane*, apex acute; *midrib raised above*; *lateral veins 8–10 pairs*, *distantly spaced*, *curved*, with short intermediate veins, faintly raised on both surfaces, *basal pair reaching to 1/3 the length of the blade*, *departing from the midrib at an acute angle*; intercostal venation finely reticulate, distinct below, faint above; *petiole 3.5–6 cm long*, flattened and wrinkled. *Syconia axillary*, *sessile*, *surface not covered by irritant hairs*, *globose*, *c. 1.8 cm diameter*, *apex umbonate*, *not perforated*; *basal bracts persistent*, *woody*, *large*, *enclosing about 3/4 of the syconium*.

Sumatra, Peninsular Malaysia, Java, Borneo, Bali, and the Philippines. Very rare in Sabah, known only by two collections, *KEP 36672* from Labuk Sugut district, and *SAN*

A 3683 from Tawau district in Sabah; in lowland mixed dipterocarp forest. Not known in Brunei, Kalimantan and Sarawak.

Basal bracts of syconia shorter, not enclosing the syconium...……..………….………….…...

F. crassiramea (Miq.) Miq.

(Latin, *crassus* = thick, *ramus* = branch or twig; with stout twigs)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 286; Corner *l.c.* 17 (1960) 384, *l.c.* (1965) 16, *l.c.* (1988) 540; Kochummen *l.c.* 144; Anderson *l.c.* 258; Whitmore, Tantra & Sutisna *l.c.* 243; Turner *l.c.* 349; Coode *et al.* (eds.) *l.c.* 213. Basionym: *Urostigma crassirameum* Miq. *l.c.* (1851) 48. Type: *Junghuhn 5* (= *UH Sheet No. 36869*), Java, Mt. Ungaran (holotype U; isotype L). Synonyms: *F. procera* Reinw. *ex* Blume var. *crassiramea* (Miq.) King *l.c.* (1887) 36; *F. crassicalyx* Elmer, Leafl. Philip. Bot. 9 (1937) 3457.

Monoecious strangler, *without free hanging aerial roots*. Twigs grey-brown or dark brown, strongly ridged. Stipules ovate to lanceolate, *c.* 1.8 × 0.8 cm, glabrous, persistent. *Leaves glabrous*; elliptic to oblanceolate, 11.5–18.5 × 3–7 cm, *base attenuate*, *margin entire*, *plane*, apex obtuse or acute; *midrib flat above*; *lateral veins 7–8 pairs*, with a number of short intermediate veins, *distantly spaced*, *curved*, *joining near the leaf margin*, faintly visible on both surfaces, *basal pair reaching up to 1/3 the length of the leaf blade, departing from the midrib at an acute angle*; intercostal venation reticulate, faint above, distinct below; *petiole 3–5.5 cm long*, *flat and wrinkled on drying*. *Syconia borne on twigs behind the leaves*, *sessile*, *globose*, *c. 1.8 cm diameter*, ripening orange to red, *apex umbonate*, *not perforated*, surface wrinkled, *not covered by irritant hairs*; *basal bracts* stiff, *short*, persistent.

Burma, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, and New Guinea. Uncommon in Sabah and Sarawak. In lowland forest. Also in Brunei and Kalimantan.

111. Stipules *c.* 3.5 cm long, drying pinkish. Syconia in clusters on twigs behind the leaves, up to 0.7 cm diameter……………...............……………………………………...………………..

F. longistipulata Kochummen

(Latin, *longi*- = long, *stipulatus* = stipulate; with long stipules)

Gard. Bull. Sing. 50 (1998) 208. Type: *Argent et al. SAN 441987*, Borneo, Sabah, Palum Tambun (holotype SAN).

Monoecious strangler, *without free hanging aerial roots*. Twigs brownish, irregularly ridged. *Stipules* lanceolate, acute, *c. 3.5 cm long*, *drying pinkish*, persistent. *Leaves glabrous*; elliptic to oblong, 11.5–13.5 × 5–6 cm, *base rounded or broadly cuneate*, *margin entire*, *plane*, apex acute; *midrib flat above*, drying pinkish below; *lateral veins 12–15 pairs*, *distantly spaced*, with short intermediate veins, *curving and joining near the leaf margin*, distinct below, visible above, *basal veins distinct*, *short*, *departing from the midrib at an acute angle*; intercostal venation reticulate, faint below, invisible above; *petiole 2–3 cm long*. *Syconia in clusters on twigs behind the leaves*, subglobose, *0.5–0.7 cm diameter*, *surface not covered by irritant hairs*, apex swollen and prominently umbonate; basal bracts small, persistent; *peduncle c. 1 cm long*, sparsely hairy.

Endemic to Borneo. Very rare, known only by the type collection from Sabah. In lowland forest, up to 150 m altitude.

Stipules up to 3 cm long. Syconia 1–3 cm diameter, not in clusters....................………112

112. Midrib strongly keeled below…………………………………..……..**68. F. virens** (in part)
Midrib rounded below...........……………………………………...……………..…..……113

113. Intercostal venation distinctly areolate below; lateral veins indistinct. Syconia subglobose……………………………………………............…………………………...

F. dubia Wall *ex* King

(Latin, *dubius* = doubtful; inference unknown)

Ann. Roy. Bot. Gard. Cal. 1, 1 (1887) 46; Ridley *l.c.* (1924) 333; Corner *l.c.* (1965) 17; Kochummen *l.c.* 146; Anderson *l.c.* 258; Whitmore, Tantra & Sutisna *l.c.* 245; Turner *l.c.* 350; Coode *et al.* (eds.) *l.c.* 214. Type: *Wall. Cat. 4561*, Penang (K?).

Monoecious strangler, without free hanging aerial roots. Twigs brownish, irregularly wrinkled on drying. *Stipules* lanceolate, acute, *c. 1.5 cm long*. *Leaves glabrous*, drying chocolate-brown; elliptic or oblong, 8–14 × 4.5–7 cm, *base rounded*, *margin entire*, *plane*, apex cuspidate with short acumen; *midrib flat above*, *rounded below*; *lateral veins 7–9 pairs*, *distantly spaced*, *faint on both surfaces*, *curved*, looping and joining near the leaf margin, *basal pair distinct, departing from the midrib at an acute angle*; *intercostal venation finely areolate*, visible on both surfaces; *petiole 2–3 cm long*. *Syconia axillary*, *solitary*, red with greenish yellow spots when ripe, *surface not covered by irritant hairs*, *irregularly wrinkled on drying*, *subglobose*, 2*.5 –3.5 × 1.5–2 cm*; *peduncle up to 0.6 cm long*; basal bracts 3, rounded.

Sumatra, Peninsular Malaysia and Borneo. Rare in Sabah and Sarawak. In lowland to lower montane forests, up to 1200 m altitude. Also in Brunei and Kalimantan.

Intercostal venation reticulate; lateral veins distinct. Syconia ovoid…………………..……
……………………………………….……………………..….....….**F. annulata** (in part)

114. Petiole hairy…………………………………………...........……………………….……

F. kerkhovenii Valeton

(A.E. Kerkhoven, 1858–1924, sometime administrator of the Ardjasari tea plantation, W Java)

In Koorders & Valeton, Bijdr. Booms. Java 11 (1906) 84; Corner *l.c.* (1965) 15, *l.c.* (1988) 541; Kochummen *l.c.* 149; Whitmore, Tantra & Sutisna *l.c.* 247; Turner *l.c.* 351. Type: *Kerkhoven s.n.*, Java, Mt. Malabar, Andjasari (BO?, L?). Synonym: *F. lamaoensis* Merr., Philip. J. Sc. 18 (1923) 55.

Monoecious strangler, without free hanging aerial roots. Twigs dark brown. Stipule not seen. *Leaves glabrous*; elliptic or oblong, 7–17 × 3–6 cm, *base cuneate*, *margin entire*, *plane*, apex acute; *midrib raised above*, *rounded below*; *lateralveins 10–12*, *distantly spaced*, *curved*, with intermediate veins in between, finely raised on both surfaces, *basal pair indistinct*, *departing from the midrib at a broad angle*; *intercostal venation reticulate*, faintly visible on both surfaces; *petiole* 1.5–2.5 cm long, *whitish hairy*, grooved on the adaxial side. *Syconia axillary*, bright red when ripe, *sessile*, subglobose, *c.* 1 cm diameter, apex convex; basal bracts small, persistent.

Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines. Very rare in Sabah and Sarawak; recorded from lowland mixed dipterocarp forest. Not known in Brunei.

Petiole glabrous……………………………...…….……….…..………...………………115

115. Lateral veins with 2–3 short intermediate veins in between. Syconia sessile…………..……
F. palaquiifolia Corner
(having leaves resembling those of *Palaquium*, Sapotaceae)
Gard. Bull. Sing. 17 (1960) 399, *l.c.* (1965) 24; Whitmore, Tantra & Sutisna *l.c.* 251. Type: *SFN 27413*, Borneo, Sabah, Mt. Kinabalu (holotype SING).
Monoecious strangler, *without free hanging aerial roots*. Twigs dark brown, 0.4–0.5 cm thick. Stipules oblong, up to 2.4 cm long, glabrous. *Leaves* coriaceous, *glabrous*; elliptic to subovate, 7–12 × 3–6.5 cm, base cuneate, *margin entire*, *plane*, apex acute; *midrib raised above*; *lateral veins* 7–13 pairs, *distantly spaced*, *with 2–3 short intermediate veins in between*, *curved*, looping and joining near the leaf margin, distinct below, faint above, *basal pair indistinct*, *departing from the midrib at a wide angle*; *intercostal venation invisible*; *petiole 1.8–3.8 cm long*, *glabrous*. *Syconia axillary*, *in pairs*, *sessile*, subglobose to pear-shaped, 0.9–1 cm diameter, surface rough on drying, apex umbonate; basal bracts rounded, persistent.
Endemic to Borneo. Very rare, known only in Sabah from Mt. Kinabalu by 3 collections and from Tawau district by one collection (*SAN 88206*). In lower montane forest, at about 1200 m altitude.

Lateral veins without short intermediate veins in between. Syconia with peduncles 0.1–0.3 cm long…………………………………………………...…………………………….
F. concinna (Miq.) Miq.
(Latin, *concinnus* = neat, pretty, elegant; probably referring to the syconia)
Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 286; Corner *l.c.* (1965) 8; Turner *l.c.* 349. Basionym: *Urostigma concinnum* Miq. *l.c.* (1847) 570. Type: unknown. Synonyms: *F. parvifolia* Miq. *l.c.* (1867) 286; *F. affinis* Wall. *ex* Kurz, J. Roy. As. Soc. Beng. 42 (1873) 105; *F. glabella* Blume var. *concinna* (Miq.) King *l.c.* (1887) 50.
Monoecious strangler, *without free hanging aerial roots*. Twigs slender, 0.1–0.2 cm thick. Stipules lanceolate, often finely hairy along the edges. Leaves elliptic to oblong; 7–9 × 2–3.5 cm, *base cuneate*, *margin entire*, *plane*, apex acute; *midrib raised above*; *lateral veins 10–15 pairs*, *distantly spaced*, *curved*, *without intermediate veins in between*, faint on both surfaces, *basal pair indistinct*, *departing from the midrib at a wide angle*; intercostal venation reticulate, *equally prominent as the lateral vein*; *petiole 1.5–2.5 cm long*, *glabrous*, slender. *Syconia in pairs*, *axillary or borne on twigs behind the leaves*, ripening white to pink to purple and black, subglobose, 0.4–0.5 cm diameter, apex slightly umbonate, *internal bristles absent; peduncle 0.1–0.3 cm long*; basal bracts falling off early.
India, Burma, S China, Indo-China, Thailand, Andaman Islands, Peninsular Malaysia, Borneo, and the Philippines. Very rare in Borneo, known only by a single collection, *KEP 36377*, from Gaya island, Semporna district, Sabah.

116. Climbers, creepers, or scandent shrubs………...………….…………….……..………...117
Epiphytes……………………………………...……….……………………...………..165

117. Leaves glabrous or sometimes pubescent with hook-like or long-straight hairs……….....118
Leaves pubescent at least below with short, rough or soft hairs…………………...……...145

118. Leaf margin toothed……………………………...…………………...........………119
Leaf margin entire, plane or revolute………………………………..…….…………120

119. Midrib sunken above; leaf apex obtuse. Stipules persistent………………...…………………
F. tulipifera Corner

(Latin, *tulipiferus* = bearing tulip-like flowers; referring to the wine-red perianth of the male flowers)

Gard. Bull. Str. Settl. 10 (1939) 150, *l.c.* (1965) 62; Whitmore, Tantra & Sutisna *l.c.* 258. Type: *Carr SFN 27763*, Borneo, Sabah, Mt. Kinabalu (holotype SING).

Dioecious creeper. *Stipules* ovate, 0.4–1.4 cm long, glabrous, *persistent*. *Leaves glabrous*; elliptic to lanceolate or oblong, 3.5–7 × 1.2–3 cm, base cuneate, *margin finely toothed*, *apex obtuse*; *midrib sunken above*; lateral veins 8–11 pairs, looping near the leaf margin, raised below, *sunken above*; *intercostal venation reticulate with fine areoles, prominent below*; petiole 0.2–0.9 cm long. *Syconia on tubercles arising from stem, solitary*, *sessile*, depressed globose, *c.* 3 × 3.5 cm, apex depressed, smooth to pimply with small lenticels, *sparsely hairy*; basal bracts 3.

Endemic to Borneo. Very rare, known only from Mt. Kinabalu in Sabah; in montane forest.

Midrib flat to slightly raised above; leaf apex acuminate. Stipules caducous...…………...….
F. subsidens Corner

(Latin, *subsidens* = sunken or depressed; probably referring to the upper part of the syconia)

Gard. Bull. Sing. 17 (1960) 454, *l.c.* (1965) 64; Whitmore, Tantra & Sutisna *l.c.* 256. Type: *Carr SFN 26443*, Borneo, Sabah, Mt. Kinabalu (holotype SING).

Dioecious creeper with long internodes. Twigs 0.2–0.4 cm thick. *Stipules caducous*. *Leaves glabrous*; elliptic, 17–22 × 9–11.5 cm, *base broadly cuneate*, *margin faintly toothed*, *apex acuminate*, acumen *c.* 1 cm long; *midrib flat to slightly raised above*; lateral veins 8–10 pairs, with many short intermediate veins, *with a gland in the axil of each basal lateral vein below*; petiole 3–7 cm long. *Syconia axillary or borne on older branches*, rose-red when ripe, subglobose, 0.6–0.8 cm diameter, *tapered into a stalk 0.5–0.8 cm long*; *with 2–3 small lateral bracts*.

Endemic to Borneo, very rare, known only by 2 collections including the type from Mt. Kinabalu in Sabah. In lower montane forest near streams, at about 1500 m altitude.

120. Midrib sunken or with distinct groove through the centre above…………..……….….…121
Midrib raised or flat above……………………………………………..…….….……129

121. Leaf apex rounded……………………………………...……………………….…122
Leaf apex acute…………………………………………..……………………….….123

122. Syconia peduncled, subglobose, *c.* 0.5 cm diameter, apex umbonate. Confined to montane forest.……………………………………………....………..…………………….…………..

F. detonsa Corner
(meaning and inference unknown)
Gard. Bull. Sing. 18 (1960) 18, *l.c.* (1965) 58; Whitmore, Tantra & Sutisna *l.c.* 244. Type: *Clemens 33456*, Borneo, Sabah, Mt. Kinabalu (holotype BM).

Dioecious climber; stem dark brown. *Leaves glabrous*; ovate or elliptic, 4–11 × 2.2–6 cm, *base broadly cuneate*, *margin entire*, *revolute*, *apex rounded* or obtuse; *midrib sunken above*; lateral veins 4–8 pairs, faintly impressed above, raised below; intercostal venation reticulate, distinct below, invisible above; petiole 0.8–3 cm long. *Syconia axillary*, *in pairs*, reddish when ripe, *subglobose*, *c. 0.5 cm diameter*, *apex umbonate*; *peduncle 0.2–0.3 cm long*; basal bracts acute.

Endemic to Borneo. In Sabah rare, known only from Mt. Kinabalu in lower montane to upper montane forests at 1600–2200 m altitude; not known in Sarawak and Brunei. Also occurs in Kalimantan.

Syconia sessile, oblong, *c.* 0.7 cm diameter, apex truncate. Confined to lowland *kerangas* forest.………………………....................………………….……………………….………..

F. kerangasensis Kochummen
(of *kerangas* forest)
Gard. Bull. Sing. 50 (1998) 207. Type: *Ilias S. 38595*, Borneo, Sarawak, Samarahan district, Sabal FR (holotype KEP; isotype SAR).

Monoecious climber. Twigs blackish. Stipules lanceolate, acute, 1–1.4 cm long, caducous. *Leaves glabrous*, drying dark brown or blackish; obovate, 6–7.5 × 2.5–4 cm, *base cuneate*, *margin entire*, *revolute*, *apex rounded*; *midrib sunken above*; lateral veins 6–8 pairs, with short intermediate veins, curving and joining near the leaf margin, faintly visible below, invisible above, basal pair extending up to 1/3 the length of the blade; intercostal venation reticulate, faintly visible below, invisible above; petiole 1–1.5 cm long, *drying black*. *Syconia borne on twigs behind the leaves*, yellowish green when ripe, *sessile*, *oblong*, *0.8–1 × 0.7 cm*, surface rugose, *apex truncate* with distinct disc; basal bracts obtuse, persistent.

Endemic to Borneo. Very rare, known only by the type from Sabal FR, Samarahan district, in Sarawak; in *kerangas* forest.

123. Leaf margin revolute………………….………………………....….………...………...124
Leaf margin plane…………………………..………..………...……….……………...126

124. Stipules persistent. Intercostal venation finely areolate below. Syconia 6–7 cm diameter, borne on the stem……………………......................……………………………….……...

F. grandiflora Corner
(Latin, *grandi*- = large; *florus* = flower; with large flowers)
Gard. Bull. Str. Settl. 10 (1939) 133, *l.c.* (1965) 60; Whitmore, Tantra & Sutisna *l.c.* 246; Coode *et al.* (eds.) *l.c.* 215. Type: *Clemens 30290*, Borneo, Sabah, Mt. Kinabalu (holotype SING).

Dioecious climber. *Stipules* lanceolate, 1–1.7 cm long, *persistent*. *Leaves glabrous*; elliptic, 10–16 × 4–7 cm, *base cuneate*, *margin entire*, *revolute*, *apex acute*; *midrib sunken above*, *keeled below*; lateral veins 6–9 pairs, with short intermediate veins, faintly visible on both surfaces, basal pair reaching to 1/3 the length of the blade; *intercostal venation finely areolate below*; petiole 1.2–2 cm long. *Syconia borne on the stem*, glabrous, marbled, *6–7 cm diameter*.

Endemic to Borneo. Very rare, known only from Mt. Kinabalu, in hill forest, at about 1000 m altitude.

Stipules caducous. Intercostal venation reticulate below. Syconia borne on twigs behind the leaves, up to 1.5 cm diameter……………….............…………………………….125

125. Basal bracts of syconia caducous…………………………...……………………………...

F. cornerii Kochummen

(E.J.H. Corner, 1906–1996, formerly prominent Professor of Tropical Botany, University of Cambridge, U.K.)

Gard. Bull. Sing. 50 (1998) 204. Type: *SAN 119744*, Borneo, Sabah, Keningau district (holotype KEP; isotype SAN).

Monoecious climber. Twigs yellowish brown, strongly grooved. *Stipules caducous*. *Leaves glabrous*, yellowish green on drying; elliptic to oblong, 12–20 × 4–6.5 cm, *base cuneate*, *margin entire*, *revolute, apex acute*; *midrib raised above with distinct sunken groove through the centre*; lateral veins 5–7 pairs, with many short veins in between, looping and joining near the leaf margin to form a looped intramarginal vein, distinct below, very faint above, basal pair reaching to almost 1/2 the length of the blade; *intercostal venation reticulate*; petiole 2.5–4 cm, wrinkled on drying. *Syconia borne on twigs behind the leaves*, *sessile*, yellowish when ripe, drying reddish brown, globose, *1.2–1.5 cm diameter,* surface smooth, apex slightly depressed, ostiole closed by 2 bracts; *basal bracts* 3, small, *caducous,* concealed by the syconium base which is thickened and ring-like with white edge.

Endemic to Borneo. Recorded from Sabah, Sarawak and Brunei. In lowland and hill mixed dipterocarp forests, up to 800 m altitude.

Basal bracts of syconia persistent...........……………………………….………..…………..

F. soepadmoi Kochummen

(E. Soepadmo, 1937–, coordinator and chief editor of the Tree Flora of Sabah and Sarawak Project)

Gard. Bull. Sing. 50 (1998) 212. Type: *S. 38376*, Borneo, Sarawak, Miri district, Lambir Hill NP (holotype KEP; isotype SAR).

Monoecious climber. *Twigs* dark brown, *angled. Stipules* lanceolate, *c.* 1.5 cm long, appressed hairy outside, *caducous*. *Leaves glabrous*, drying greenish yellow; oblong or oblanceolate, 9–13 × 2.8–3.7 cm, *base cuneate*, *margin entire*, *revolute*, *apex acute*; *midrib sunken above*; lateral veins 5–7 pairs, with a number of short intermediate veins, curving and joining near the leaf margin to form looped intramarginal vein; *intercostal venation reticulate*, distinct below, very faint to inconspicuous above; petiole 1–1.5 cm long, drying black, sparsely hairy. *Syconia borne on twigs behind the leaves*, *sessile*, *in pairs,* pale green when ripe, subglobose, *0.6–0.8 cm diameter,* apex faintly depressed, ostiole closed by 2 apical bracts, surface rugose with five prominent ridges from apex to base; *basal bracts* with rounded apices, *persistent*.

Endemic to Borneo. Very rare, known only by the type from Sarawak, in lower montane forest by streams, at about 1400 m altitude. A sterile collection from Brunei, *BRUN 5332*, from Sg. Belalong, a juvenile stage collection, probably belongs here.

126. Stipules persistent. Syconia sessile, base not narrowed into a long stalk.................………..

F. paracamptophylla Corner

(Greek, near or resembling *F. acamptophylla*)

Gard. Bull. Sing. 17 (1960) 387, *l.c.* (1965) 17; Whitmore, Tantra & Sutisna *l.c.* 251; Coode *et al.* (eds.) *l.c.* 216. Type: *Anderson S. 9103*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype SAR).

Monoecious climber. Twigs pale whitish, grooved. *Stipules* finely hairy outside, lanceolate, up to 3.5 cm long, *persistent*. *Leaves glabrous*, thick-coriaceous; oblong or lanceolate, 10–28 × 3.5–10 cm, *base rounded to subcordate*, *margin entire*, *plane*, *apex acute*; *midrib sunken above*, prominent below; lateral veins 8–11 pairs, faintly raised on both surfaces, looping and joining near the leaf margin; intercostal venation reticulate, distinct below, faint above; petiole 1.5–4 cm long, irregularly wrinkled on drying. *Syconia in pairs on twigs behind the leaves*, *sessile*, subglobose to ellipsoid, 1.3–1.6 cm diameter, yellowish when ripe, surface rugose on drying; *base not narrowed into a long stalk*, apex disc-like; basal bracts with rounded apices, persistent.

Endemic to Borneo. Uncommon in Sarawak; very rare in Sabah, known by two collections, *SAN 105173* from Beaufort district and *SAN 7765* from Sipitang district. In lowland mixed dipterocarp forest by streams, including *kerangas* forest. Also in Brunei and Kalimantan.

Stipules caducous. Base of syconia narrowed into a long stalk…………..……….……...127

127. Petiole 2.5–5 cm long. Intercostal venation distinctly areolate below. Syconia apex umbonate………………………………........…………………...……….…………………..

F. apiocarpa (Miq.) Miq.

(Greek, *apion* = pear, *karpos* = fruit; the pear-shaped syconia)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 269; King *l.c.* (1888) 70; Merrill *l.c.* (1921) 220; Ridley *l.c.* (1924) 338; Burkill *l.c.* 1020; Corner *l.c.* (1965) 60; Kochummen *l.c.* 140; Whitmore, Tantra & Sutisna *l.c.* 240; Turner *l.c.* 348; Coode *et al.* (eds.) *l.c.* 21. Basionym: *Urostigma apiocarpa* Miq. *l.c.* (1861) 440. Type: *HB 796* (= *UH Sheet No. 39621*), Sumatra, Seboga (holotype U; isotype L). Synonyms: *F. tetangis* Miq. *l.c.* (1861) 432; *Synoecia apiocarpa* (Miq.) Miq. *l.c.* (1867) 313.

Dioecious climber. Twigs brownish, almost flat, grooved. *Stipules* lanceolate, *c.* 1 cm long, acute, glabrous, *caducous*. *Leaves glabrous*; elliptic, ovate or narrowly obovate, 15–23 × 6–9.5 cm, base rounded to broadly cuneate, *margin entire*, *plane*, *apex acute*; *midrib sunken above*; lateral veins 4–5 pairs, raised below, faint above; *intercostal venation finely reticulate to areolate*, *very distinct below*, invisible above; *petiole 2.5–5 cm long*. *Syconia axillary*, *pear-shaped*, 4–6.5 × 1.5–2.5 cm, smooth, *apex umbonate*, *base tapered into a stalk 2.5–3.5 cm long*.

Sumatra, Peninsular Malaysia and Borneo. Rare in Sabah, recorded from Papar and Beaufort districts only; more common in Sarawak. In lowland mixed dipterocarp forest, including peatswamp forest. Also in Brunei and Kalimantan.

Two varieties are recognised, viz. var. *apiocarpa* and var. *villosa* Corner (*cf.* Corner *l.c.* 1965).

Petiole 0.6–2 cm long. Intercostal venation not distinctly areolate below. Apex of syconia not umbonate……..……………………....……..……………………...…………………128

128. Petiole 0.6–1.2 cm long. Hairs on leaves hook-like…..…..........……………………………..

F. recurva Blume (in part)

(Latin, *recurvus* = recurved; the leaf margin)

Bijdr. Fl. Ned. Ind. (1825) 457; Merrill *l.c.* (1921) 226; Ridley *l.c.* (1924) 335; Burkill *l.c.* 1030; Corner *l.c.* (1965) 56; Whitmore, Tantra & Sutisna *l.c.* 252; Turner *l.c.* 353; Coode *et al.* (eds.) *l.c.* 217. Type: *Blume s.n.* (= *RHL Sheet No. 908283226*), Java, Bogor, Parang (holotype L). Synonyms: *F. strigosa* Blume *l.c.* 441; *F. leptocarpa* Steud., Nom. Bot. ed. 2(1840) 636; *F. spanogheana* Miq. *l.c.* (1848) 451; *F. villipes* Miq. *l.c.* (1848) 451; *F. samarensis* Merr., Philip. J. Sc. 18 (1921) 60.

Dioecious climber, often rooting from stem. *Stipules* ovate to lanceolate, sparsely or densely hairy, *caducous*. *Leaves glabrous or pubescent with hook-like hairs*, often pitted on the upper surface; ovate, lanceolate, elliptic or oblong, 3–16 × 1.5–6 cm, base rounded, truncate or narrowly cordate, *margin entire*, *plane*, *apex acute*; *midrib sunken above*; lateral veins 3–7 pairs, raised below, very faint above, basal pair reaching to 1/2 the length of the blade; *intercostal venation not distinctly areolate*, *faint to distinct below*, faint to invisible above; *petiole 0.6–1.2 cm long*. *Syconia in clusters on twigs behind the leaves*, glabrous or hairy, depressed globose, 0.5–0.9 cm diameter, *base often narrowed and stalk-like*, sessile or shortly peduncled; *apex truncate with distinct ostiole*; basal bracts large, persistent, hairy.

Thailand, Sumatra, Peninsular Malaysia, Java, Lombok, Borneo, and the Philippines. Uncommon in Sabah and Sarawak. In lowland to lower montane forests, up to 1600 m altitude. Also in Brunei and Kalimantan.

Five varieties are recognised in Sabah and Sarawak, viz. var. *bridelioides* Corner, var. *elegantior* Corner, var. *lasiocarpa* Corner, var. *recurva*, and var. *ribesoides* Wall. *ex* Miq. (*cf.* Corner *l.c.* (1965) 56).

Petiole 1–2 cm long. Hairs on leaves straight.........……..……………………….…………...

F. sagittata Koen. *ex* Vahl

(Latin, *sagittatus* = shaped like an arrow-head with two equal sharp basal lobes directed down wards; the leaves)

Symb. Bot. 1 (1790) 83; Backer & Bakhuizen *l.c.* 22; Corner *l.c.* (1965) 55; Kochummen *l.c.* 155; Whitmore, Tantra & Sutisna *l.c.* 253; Turner *l.c.* 353. Type: unknown. Synonyms: *F. compressicaulis* Blume *l.c.* 439; *F. ramentacea* Roxb., Fl. Ind., ed. Carey, 3 (1832) 547; *F. crininervia* Miq. *l.c.* (1861) 432; *F. subrigida* Miq. *l.c.* (1861) 433; *F. leptocarpa* Steud. var. *borneensis* Miq., var *crassa* Miq., var. *subglabra* Miq., var. *timorensis* Miq. *l.c.* (1867) 280.

Dioecious climber. *Stipules* lanceolate, densely long-hairy, *caducous*. *Leaves glabrous above*, *sparsely long-hairy on midrib and veins below*, *hairs straight*; *sagittate* or elliptic or oblong, 7–18 × 2.5–8 cm, base cuneate or truncate, *margin entire*, *plane*, *apex acute*; *midrib sunken above*; lateral veins 6–8 pairs, *sunken above*, distinctly raised below; *intercostal venation invisible on both surfaces or scalariform and visible below*; *petiole 1–2 cm long*, channelled on the adaxial side. *Syconia axillary*, *in pairs or solitary*, occasionally in clusters, orange or red when ripe, *sessile or stalked*, glabrous or hairy, depressed globose, 0.3–1 cm diameter, *constricted at the base into a stalk*, *apex with a distinct ostiole*; basal bracts small, persistent.

Sikkim, Assam, Chittagong, Burma, Andaman Islands, Thailand, Indo-China, S China, Hainan, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Maluku, Timor, Key Is., and Caroline Islands. Rare in Sabah and Sarawak; in lowland and hill mixed dipterocarp forests by streams. Not known in Brunei.

Three varieties are recognised in Sabah and Sarawak, namely var. *adhaerens* (Miq.) Corner, var. *oligosperma* (Miq.) Corner, and var. *sagittata* (*cf.* Corner *l.c.* 18, 1960).

129. Leaf margin revolute…………………..….....…………………..............………………..130

Leaf margin plane………………………....………..……..………………………...…...137

130. Leaf base rounded or subcordate…………...………………………….…….….……….131
Leaf base cuneate…………………………....…………………...…………..…………136

131. Leaf apex obtuse or rounded; petiole up to 1 cm long. Syconia up to 0.3 cm diameter……………………………………......…………………….……………………...

F. excavata King

(Latin, *excavatus* = hollowed out in a curve; the apical part of syconia)

Ann. Roy. Bot. Gard. Calc. 1, 2 (1888) 127; Merrill *l.c.* (1921) 223; Ridley *l.c.* (1924) 344; Corner *l.c.* (1965) 57; Kochummen *l.c.* 146; Whitmore, Tantra & Sutisna *l.c.* 245; Turner *l.c.* 350. Syntypes: *Beccari PB 1368*, Borneo (FI); *King's coll. 5404*, *5985*, Peninsular Malaysia, Perak (CAL, K?).

Dioecious, *scandent shrub*. Young twig soft-hairy. *Leaves glabrous*; ovate to orbicular, 3–3.75 cm long, *base rounded*, *margin entire*, *revolute*, *apex obtuse to rounded*; *midrib raised above*; lateral veins 3–5 pairs; *intercostal venation reticulate*, *prominent below*; *petiole 0.5–1 cm long*, hairy. *Syconia sessile*, *in clusters*, *axillary*, depressed globose, *c. 0.3 cm diameter*, orange red when ripe; basal bracts 3, persistent.

Peninsular Malaysia and Borneo. Rare in Sabah and Sarawak; in lowland to hill forests, up to 900 m altitude. Not known in Brunei.

Leaf apex acute; petiole up to 10 cm long. Syconia up to 6 cm diameter…………...…....132

132. Petiole 4–10 cm long. Syconia up to 6 cm diameter, with warty surface….….……….……...

F. densechini Corner

(Latin, *densus* = dense, *echinus* = slender, prickle- or spine-like appendages; syconia covered with dense prickles)

Gard. Bull. Str. Settl. 10 (1939) 130, *l.c.* (1965) 60; Whitmore, Tantra & Sutisna *l.c.* 244. Type: *Carr SFN 26807*, Borneo, Sabah, Mt. Kinabalu (holotype SING; isotype K?).

Dioecious root-climber. *Twigs* pale yellow, *hollow*, with distinct ring-like scars. Stipules lanceolate, 1.5–4.5 cm long, caducous. *Leaves glabrous*; ovate, 12–18 × 7–10.5 cm, *base rounded or shallowly cordate*, *margin entire*, *revolute*, *apex acute*; *midrib raised above*; lateral veins 4–8 pairs, raised on both surfaces; intercostal venation reticulate, faint with fine distinct areoles; *petiole 4–10 cm long*. *Syconia axillary or borne on twigs behind the leaves*, *solitary or in pairs*, ripening dark brown with paler markings, ellipsoid, *c. 7 × 6 cm*, *surface armed with short*, *slender prickles*, *apex umbonate with 5 large bracts around the ostiole*, base tapered into a stalk; *peduncle 0.2–0.5 cm long*; basal bracts 3.

Endemic to Borneo. Very rare, known only from Sabah by 2 collections. In lowland to lower montane forests, up to 1600 m altitude.

Petiole up to 3.5 cm long. Syconia up to 2 cm diameter.…………….………..…………..133

133. Leaf with a distinct gland in the axil of each of the basal lateral veins below. Syconia arising from tubercles on stem and branches………………………..…………………...………..

F. allutacea Blume

(Latin, *allutaceus*, mispelling of *alutaceus* = leather-coloured, pale brown; the drying leaves)

Bijdr. Fl. Ned. Ind. (1825) 457; King *l.c.* (1888) 131; Ridley *l.c.* (1924) 344; Backer & Bakhuizen *f. l.c.* 22; Corner *l.c.* (1965) 58; Kochummen *l.c.* 139; Whitmore, Tantra & Sutisna *l.c.* 239; Turner *l.c.* 348. Type: *Blume s.n.* (= *RHL Sheet No. 908188212*), Java, Mt. Salak (holotype L). Synonyms: *F. teysmanniana* Miq. *l.c.* (1859) 319; *F. allutacea* Blume var. *teysmanniana* (Miq.) King *l.c.* (1888) 131; *F. areolata* Elmer, Leafl. Philip. Bot. 4 (1911) 1252; *F. alutacia* Backer, Bekn. Fl. Java 6 (1948) 21.

Dioecious, *scandent shrub*. Twigs warty. Stipules ovate to lanceolate, *c*. 1 cm long, hairy. *Leaves glabrous*, upper surface smooth, shining, grey-brown on drying; elliptic, oblong or ovate, 10–17.5 cm long, *base rounded*, *margin entire*, *revolute*, *apex acute*; *midrib raised above*; lateral veins 6–7 pairs, distinct below, faint to invisible above, basal veins short, *with a black gland in the axil of each vein below*; intercostal venation reticulate, minutely areolate, distinct below, invisible above; *petiole 2–3 cm long*. *Syconia solitary*, *in pairs*, *or in fascicles on tubercles arising from stem and branches*, globose, *0.7–1.2 cm diameter*, smooth, reddish when ripe; *peduncle c. 2.5 cm long*; basal bracts 3, united.

Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, and Maluku. In Sabah and Sarawak very rare, known only from Mt. Kinabalu in Sabah; in hill mixed dipterocarp forest up to 900 m altitude. Not known in Brunei.

Leaf without glands in the axils of basal lateral veins below. Syconia axillary………..…134

134. Lower leaf surface scabrous (rough to the touch)……………..……..……………………….

F. sabahana Kochummen

(of Sabah)

Gard. Bull. Sing. 50 (1998) 211. Type: *Ashik SAN 114907*, Borneo, Sabah, Pensiangan district, Pandewan, Mesopo R. (holotype SAN).

Dioecious root-climber. Twigs flat, greyish yellow. Stipules ovate to lanceolate, acute, *c*. 2 cm long, subpersistent. *Leaves glabrous*, greyish yellow on drying, *undersurface scabrous*; ovate to lanceolate, 12.5–18.5 × 7–10 cm, *base cordate or subcordate, margin entire*, *revolute*, *apex acute*; *midrib flat above*; lateral veins 3–4 pairs, prominently raised below, flat or faintly raised above, basal pair reaching more than 1/2 the length of the blade, *without glands in the axils below*; intercostal venation scalariform or reticulate, distinct below, faint above; *petiole 1–2 cm long*, sparsely hairy. *Syconia in clusters*, *axillary*, globose, *0.6–1.1 cm diameter*, surface smooth on drying, *apex depressed, base narrowed into a cylindrical stalk*; *basal bracts densely long-hairy*.

Endemic to Borneo. Known only by 3 collections from Sabah, *SAN 83817* and *SAN 118638* from Keningau district, and the type. In disturbed lowland mixed dipterocarp forest.

Lower leaf surface smooth…………..........…...…….….………......…………………...135

135. Syconia in clusters, base narrowed into a stalk.……………...…………..**F. recurva** (in part)

Syconia solitary, base not narrowed into a stalk but with distinct peduncle………...………...

F. diandra Corner

(Greek, *diandrus* = two-stamened; the male flowers)

Gard. Bull. Sing. 19 (1962) 393, *l.c.* (1965) 60; Whitmore, Tantra & Sutisna *l.c.* 244. Type: *Corner S. 13740*, Borneo, Sarawak (holotype CGE).

Dioecious climber. Twigs dark brown, ridged. Stipules lanceolate, acute, up to 1.2 cm long. *Leaves glabrous, lower surface smooth*; elliptic to ovate or lanceolate, 4–14 × 2–8.5 cm, *base rounded to narrowly cordate*, *margin entire*, *revolute*, *apex acute*; *midrib flat above*; lateral veins 3–5 pairs, faint above, curving and joining near the leaf margin, *without glands in the axils of basal pair below*; intercostal venation finely reticulate or areolate; *petiole 0.4–3.5 cm long*. *Syconia solitary*, *axillary*, subglobose, *1.5–2 cm diameter*, apex faintly umbonate; surface reddish brown, verrucose; *peduncle up to 1 cm long*; basal bracts 3, caducous.

Endemic to Borneo. Very rare, known only by three collections, *S. 13740*, *S. 38570* and *S. 46239* from Kuching district in Sarawak. In lowland forest, including limestone habitat.

136. Petiole 1.5–2.5 cm long. Leaves strongly pitted below. Syconia borne on stout, leafless, finger-like twigs arising from stem, 2–5 cm diameter……..................……...………………..

F. iliaspaiei Kochummen

(Ilias Paie, plant collector of the Sarawak Herbarium)

Gard. Bull. Sing. 50 (1998) 207. Type: *Ilias S. 42527*, Borneo, Sarawak, path to G. Silantek (holotype SAR; isotype CGE).

Dioecious climber. Twigs reddish brown. Stipules subpersistent. *Leaves glabrous*, *lower surface distinctly pitted*; elliptic, 10–12 × 2.5–4 cm, *base cuneate*, *margin entire*, *revolute*, *apex acute*; *midrib raised above*; lateral veins 5–6 pairs, very faintly visible on both surfaces; intercostal venation reticulate, areolate, distinct below; *petiole 1.7–2 cm long*. *Syconia borne on stout*, *leafless*, *finger-like twigs arising from the stem*, greenish with white dots when ripe, ellipsoid, *c. 7 × 2.5 cm*, apex acute, *base tapered into a stalk up to 1 cm long*; *peduncle 2.5–3 cm long*; basal bracts tiny.

Endemic to Borneo. Very rare, known only from the type locality in Sarawak. In lowland mixed dipterocarp forest, at *c.* 200 m altitude.

Petiole up to 1 cm long. Leaves not pitted below. Syconia on twigs and branches behind the leaves, subglobose, *c.* 0.5 cm diameter……………………………………………………..

F. gamostyla Kochummen

(Greek, *gamo-* = united, *stulos* = style; flowers with united styles)

Gard. Bull. Sing. 50 (1998) 206. Type: *SAN 107123*, Borneo, Sabah, Kinabatangan district, Tongod (holotype SAN).

Dioecious climber. *Twigs* dark brown, *hollow*. Stipules lanceolate, acuminate, *c.* 0.4 cm long, caducous. *Leaves glabrous*, *lower surface not pitted*; obovate or elliptic, 7–11 × 2.5–5.5 cm, *base cuneate*, *margin entire*, *revolute*, *apex acute*; *midrib flat above*; lateral veins 5–6 pairs, with shorter veins in between, basal pair short, raised below, very faint above; intercostal venation finely reticulate, distinct below, invisible above; *petiole 0.7–1 cm long*. *Syconia borne on twigs and branches behind the leaves*, *in clusters*, ripening red, *subglobose*, *c. 0.5 cm diameter*, apex umbonate with slight depression in the centre; *peduncle 1–1.3 cm long*; basal bracts persistent.

Endemic to Borneo. Very rare, known only from the type locality in Sabah. In lowland mixed dipterocarp forest.

137. Lateral veins more than 15 pairs, closely spaced, straight towards the leaf margin……...…...

F. subcordata Blume

(Latin, *sub-* = somewhat, *cordatus* = heart-shaped; the leaf)

Bijdr. Fl. Ned. Ind. (1825) 440. Type: *Zippelius 1328* (= *RHL Sheet No. 9081882159*), Lesser Sunda Islands, Timor (L).

Only var. *malayana* is present in Sabah and Sarawak.

var. **malayana** Corner

(of Malaya)

Gard. Bull. Sing. 17 (1960) 396; *l.c.* (1965) 21; Kochummen *l.c.* 157; Whitmore, Tantra & Sutisna *l.c.* 255; Turner *l.c.* 354. Type: *Curtis s.n.*, Peninsular Malaysia, Selangor (holotype SING).

Tall, monoecious climber. Twigs *c.* 0.6 cm thick. *Leaves glabrous*, drying greenish yellow; elliptic, 10.5–19 × 3.8–8.5 cm, *base cuneate, margin entire, plane, apex acute*; *midrib raised above*; *lateral veins more than 15 pairs, closely spaced, straight towards the leaf margin*, with shorter veins in between, raised on both surfaces, joining near the leaf margin to form distinct looped intramarginal vein; *intercostal venation invisible*; petiole 1.5–2 cm long, drying yellow. Syconia subcylindrical, 3.5–5 × 2–2.5 cm; basal bracts fused and forming a ring-like structure.

Peninsular Malaysia and Borneo. In Sabah and Sarawak, very rare, known by a single collection *SAN A 4365* from Mt. Trus Madi in Sabah, and by three collections from Lambir Hill NP (*RDH 109*), Kapit (*S. 28380*) and G. Santubong (*Corner s.n.*) in Sarawak. In hill mixed dipterocarp forest, up to 800 m altitude. Not known in Brunei.

Lateral veins less than 15 pairs, well-spaced, curved towards the leaf margin.…………..138

138. Lateral veins up to 5 pairs…………………………………..……….……………….139
Lateral veins more than 5 pairs……………………………...………………….…143

139. Leaf apex cuspidate……………………………………………..………………….…

F. heteropleura Blume

(Greek, *heteros* = different, uneven, *pleuron* = rib, nerve; the unevenly veined leaf blade)

Bijdr. Fl. Ned. Ind. (1825) 466; Corner *l.c.* (1965) 77; Kochummen *l.c.* 148; Whitmore, Tantra & Sutisna *l.c.* 247; Turner *l.c.* 351. Type: *Blume s.n.* (= *RHL Sheet No. 9081882147*), Java (holotype L). Synonyms: *F. radicans* Roxb., Fl. Ind., ed. Carey, 3 (1832) 536; *F. urophylla* Wall. *ex* Miq. *l.c.* (1848) 429; *F. intermedia* Griff., Ic. Pl. As. 4 (1854) *t.* 556; *F. caudatifolia* Warb. *in* Perkin, Fragm. Fl. Philip. 3 (1905) 194; *F. eucaudata* Elmer, Leafl. Philip. Bot. 1 (1906) 40.

Dioecious, woody climber. Twigs brownish, slender, glabrous or hairy, rounded. *Leaves glabrous* or hairy beneath, drying reddish brown; elliptic to narrowly obovate, 6–14 × 2.5–5.5 cm, *base cuneate, slightly asymmetric, margin entire, plane, apex cuspidate, acumen 2–3 cm long*; *midrib flat above*, sometimes appear impressed; *lateral veins 2–4 pairs, well-spaced, curved*, raised below, faint to invisible above, looping and joining near the leaf margin, basal pair extending to more than 1/2 the length of the blade; intercostal venation scalariform or reticulate, distinct below, invisible above; petiole 0.5–1.5 cm long. *Syconia axillary, rough hairy*, globose, 0.4–0.8 cm diameter, with small ostiole at the apex; *peduncle slender, 0.3–1 cm long.*

Assam, Bhutan, Bengal, Burma, Indo-China, Hainan, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, and Ambon. Common in Sabah and Sarawak. In lowland to lower montane forests, up to 1800 m altitude. Not known in Brunei.

Two varieties are recognised in Sabah and Sarawak, viz. var. *heteropleura* and var. *hirta* Corner. The latter differs from the former in having reddish brown hairy twigs and leaf undersurface, and shorter peduncle up to 0.3 cm long.

Leaf apex rounded or obtuse……………………………..…………...………………140

140. Leaf base asymmetric…………………………………..………....…….……………141
Leaf base symmetric……………………………………...……......…………………142

141. Stipules persistent. Syconia borne on stem, velvety hairy, 4–8 cm diameter...............……..

F. punctata Thunb.

(Latin, *punctatus* = dotted; the lower leaf surface)

Diss. Fic. (1786) 9; Merrill *l.c.* (1921) 226; Ridl. *l.c.* (1924) 338; Backer & Bakhuizen *f. l.c.* 21; Corner *l.c.* (1965) 61; Kochummen *l.c.* 154; Whitmore, Tantra & Sutisna *l.c.* 252; Turner *l.c.* 353; Coode *et al.* (eds.) *l.c.* 217. Type: *Thunberg s.n.*, Java (UPS). Synonyms: *F. falcata* Thunb. *l.c.* 5; *F. macrocarpa* Blume *l.c.* 459.

Dioecious woody creeper. Stipules, twigs and petioles finely appressed hairy. *Stipules persistent. Leaves glabrous*, drying yellowish green, *lower surface tesselate with minute stomatal pits*; obovate or elliptic, 2–5 × 1.5–3.5 cm, *base cuneate*, *often distinctly asymmetric*, *margin entire*, *plane*, *apex rounded*; *midrib flat above*; *lateral veins 3–5 pairs*, *well-spaced*, *curved*, faintly visible below, invisible above; intercostal venation reticulate, visible below only; petiole 0.2–1 cm long. *Syconia arising from woody tubercles on the stem and older branches*, globose to pear-shaped, *5–11 × 4–8 cm*, rugose, *finely velvety hairy*; basal bracts 3, triangular; *peduncle up to 2 cm long*.

Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, and Sulawesi. Uncommon in Sabah and Sarawak. In lowland to lower montane forests. Also in Brunei and Kalimantan.

Stipules caducous. Syconia axillary, glabrous, 0.5–0.6 cm diameter.…….………..…………

F. callicarpides Corner

(Greek, *callicarpides* = somewhat similar to *F. callicarpa*, a synonym of *F. aurantiacea*)

Gard. Bull. Sing. 18 (1960) 17, *l.c.* (1965) 57; Whitmore, Tantra & Sutisna *l.c.* 242. Type: *Anderson S. 9890*, Borneo, Sarawak, Miri (holotype SAR).

Dioecious, *slender climber*. Twigs 0.1–0.15 cm thick, hairy. *Stipules c.* 0.3 cm long, glabrous, *caducous*. *Leaves glabrous*; elliptic to obovate, 1.2–3.5 × 0.4–2 cm, *base asymmetric*, one side cuneate and the other subcordate, *margin entire*, *plane*, *apex rounded or obtuse*; *midrib raised above*; *lateral veins 3–4 pairs*, *well-spaced*, *curved*, basal pair reaching to 1/2 the length of the blade; *intercostal venation invisible*; petiole 0.2–0.4 cm long, hairy. *Syconia axillary*, *in pairs*, *glabrous*, red when ripe; depressed globose, *0.5–0.6 cm diameter*; basal bracts 3; *peduncle 0.1–0.15 cm long.*

Endemic to Borneo. Known only from Sarawak, where it is locally common in peatswamp forest.

142. Syconia subglobose, up to 0.5 cm diameter…………..…………………...…………………

F. disticha Blume

(Latin, *distichus* = arranged in two opposite rows; the leaves)

Bijdr. Fl. Ned. Ind. (1825) 458; Miquel *l.c.* (1867) 294; Backer & Bakhuizen *f. l.c.* 21; Corner *l.c.* (1965) 58; Kochummen *l.c.* 145; Turner *l.c.* 350. Type: *Blume s.n.* (= *RHL Sheet No. 908188547*), Java, Mt. Salak (holotype L). Synonyms: *F. disticha* Blume *var. brunneinervia* Hochr., Candollea 2 (1925) 332.

Dioecious creeper. Two minutely notched; *midrib flat above*; *lateral veins 4–5 pairs*, *well-spaced*, *curved*, visible below, invisible above, basal pair reaching to 1/2 the length of the blade; intercostal venation finely reticulate, areolate, *distinct below*; petiole 0.3–1 cm long, channelled on the adaxial side. *Syconia in pairs*, *axillary*, yellowish green when ripe, *subglobose*, *c. 0.5 cm diameter*; *peduncle 0.2–0.3 cm long*; basal bracts caducous.

Burma, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, and Maluku. Rare in Borneo, known only from Mt. Kinabalu in Sabah; in hill mixed dipterocarp to lower montane forests, at 500–1800 m altitude.

Syconia ellipsoid to pear-shaped, *c.* 10 × 3 cm, with white lines and spots…………..……..

F. aurantiacea Griff.

(Latin, *auranticeus* = orange; the ripe syconia)

Notul. 4 (1854) 394, *t.* 535; King *l.c.* (1888) 67; Ridley *l.c.* (1924) 338; Backer & Bakhuizen *f. l.c.* 21; Corner *l.c.* (1965) 61; Kochummen *l.c.* 140; Whitmore, Tantra & Sutisna *l.c.* 240; Turner *l.c.* 348. Type: unknown. Synonyms: *Synoecia sumatrana* Miq. *l.c.* (1859) 329; *F. gibbosa* Blume var. *pygmea* Miq. *l.c.* (1860) 431; *F. callicarpa* Miq. *l.c.* (1867) 268.

Dioecious root-climber, with tufts of short adventitious roots. Stipules lanceolate, acute, up to 1.3 cm long, caducous. *Leaves glabrous*; elliptic to narrowly obovate, 6–12 × 1–7.5 cm, base broadly cuneate, *symmetric*, *margin entire*, *plane*, *apex rounded; midrib faint and flat above*; *lateral veins 3–4 pairs*, *well-spaced*, *curved*, faintly raised below, almost invisible above; *intercostal venation areolate*, *distinct and prominent below*, invisible above; petiole 0.7–1 cm long. *Syconia on twigs behind the leaves or on woody tubercles arising from stem and branches*, *glabrous*, *with pale lines and spots*, *ellipsoid or pear-shaped*, *c. 10 × 3 cm*, *ripening orange to carrot-red*, apex with projecting bracts; *peduncle c. 2 cm long.*

Burma, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Bali, and Sumbawa. Rare in Sabah and Sarawak; in lowland mixed dipterocarp to lower montane forests, up to 1700 m altitude. Not known in Brunei.

Three varieties are recognised in Sabah and Sarawak, viz. var. *angustifolia* Corner, var. *aurantiacea*, and var. *parvifolia* Corner. Var. *angustifolia* and var. *parvifolia* differ from var. *aurantiacea* by the smaller leaves, while var. *angustifolia* can be distinguished from var. *parvifolia* by its narrower leaves.

143. Stipules curving away from the twigs. Leaves with glands in the axils of basal pair of lateral veins……………………………………....…………………………….………..…...…..

F. subulata Blume.

(Latin, *subulatus* = awl-shaped; the buds)

Bijdr. Fl. Ned. Ind. (1825) 461; Merrill *l.c.* (1921) 226; Ridley *l.c.* (1924) 329; Backer & Bakhuizen *f. l.c.* 20; Corner *l.c.* (1965) 76; Kochummen *l.c.* 158; Anderson *l.c.* 261; Whitmore, Tantra & Sutisna *l.c.* 256; Turner *l.c.* 354. Type: *Blume s.n.* (= *RHL Sheet No. 9081882180*), Java, in montane forest near Parang (holotype L). Synonyms: *F. saxatalis* Blume *l.c.* 460; *F. ellipsoidea* Miq. *l.c.* (1867) 230; *F. sikkimensis* Miq. *l.c.* (1867) 225; *F. confusa* Elmer, Leafl. Philip. Bot. 1 (1906) 47; *F. driveri* Elmer, Leafl. Philip. Bot. 7 (1914) 2397.

Dioecious climber. Twigs slender, 0.2–0.3 cm thick, slightly angled. *Stipules* narrowly lanceolate, 1.5–2.5 cm long, *almost always curving away from the twigs*. *Leaves glabrous*; elliptic to oblong, 6.5–26 × 2.5–10 cm, *base cuneate*, *asymmetric*, *margin entire*, *plane*, apex acute; *midrib flat above*; *lateral veins 6–15 pairs*, *well-spaced*, *curved*, with shorter veins in between, faintly visible on both surfaces, *often with a gland in each axil of the basal pair*; intercostal venation reticulate, faint; petiole 0.3–1.2 cm long. *Syconia on twigs behind the leaves*, *in clusters*, ovoid or globose, 0.4–0.7 cm diameter; *peduncle up to 0.5 cm long*; with many bracts at the base of peduncles.

Sikkim, S China, Malesia and Solomon Islands. Common in Sabah and Sarawak; in lowland mixed dipterocarp to lower montane forests, including limestone forest, up to 1700 m altitude. Not known in Brunei.

Stipules not curving away from the twigs. Leaves without glands in the axils of basal pair of lateral veins…………………………………………...…………………….………...144

144. Leaf base cuneate. Syconia ovoid, 1.5–2 cm diameter………………………..…………...

F. depressa Blume

(Latin, *depressus* = flattened from above; the syconia)

Bijdr. Fl. Ned. Ind. (1825) 450; Miquel *l.c.* (1867) 286; Backer & Bakhuizen *f. l.c.* 31; Corner *l.c.* (1965) 12; Kochummen *l.c.* 145; Whitmore, Tantra & Sutisna *l.c.* 244; Turner *l.c.* 350. Type: *Blume s.n.*, Java, Mt. Salak (holotype L?). Synonyms: *F. pruniformis* Blume *l.c.* 451; *F. johnsoni* Elmer *l.c.* (1906) 190; *F. iwahigensis* Elmer *l.c.* (1912) 1381.

Monoecious climber. *Twigs grey-white to grey-brown,* 0.4–0.5 cm thick, with distinct stipular scars. *Stipules not curving away from the twigs*, lanceolate, acute, *c.* 1 cm long. *Leaves glabrous*; elliptic, 7.5–16.5 × 3–7.5 cm, *base cuneate*, *margin entire*, *plane*, apex acute; *midrib flat or raised above*; *lateral veins 6–10 pairs, well-spaced, curved,* with short intermediate veins in between, joining near the leaf margin, raised below, faint above, *without glands in the axils of basal pair*; intercostal venation reticulate, faintly visible on both surfaces; petiole 1.5–2.5 cm long. *Syconia axillary*, greenish yellow when ripe, *ovoid* to ellipsoid, *2–3 × 1.5–2 cm*, *surface strongly and irregularly wrinkled on drying; peduncle 1.5–3.5 cm long.*

Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, and Bali. Common in Sabah, rare in Sarawak; in lowland and hill mixed dipterocarp forests, including swamp forest, up to 600 m altitude. Not known in Brunei.

Leaf base rounded to subcordate. Syconia subglobose, 1.2–1.5 cm diameter……….......……

F. globosa Blume

(Latin, *globosus* = round like a ball; the syconia)

Bijdr. Fl. Ned. Ind (1825) 449; Miquel *l.c.* (1867) 285; King *l.c.* (1887) 27; Merrill *l.c.* (1921) 224; Ridley *l.c.* (1924) 333; Burkill *l.c.* 1026; Backer & Bakhuizen *f. l.c.* 33; Corner *l.c.* (1965) 12; Kochummen *l.c.* 147; Whitmore, Tantra & Sutisna *l.c.* 246; Turner *l.c.* 351; Coode *et al.* (eds.) *l.c.* 215. Type: *Blume s.n.* (= *RHL Sheet No. 908188756*), Java, Parang (holotype L). Synonyms: *Urostigma onustum* Wall. *ex* Miq. *l.c.* (1847) 575; *U. globosum* (Blume) Miq. *l.c.* (1859) 337; *U. manok* Miq. *in* Zollinger *l.c.* (1854) 90; *F. manok* (Miq.) Miq. *l.c.* (1867) 261.

Monoecious climber. Twigs grey-brown, striate. *Stipules* glabrous, narrowly lanceolate, acute, *c.* 3 cm long, *not curving away from the twigs*. *Leaves glabrous*, drying to chocolate-brown; oblong, 8.5–19 × 2.5–8 cm, *base broadly rounded to slightly subcordate*, *margin entire*, *plane*, apex acute; *midrib raised above*; *lateral veins c. 10 pairs*, *well-spaced*, *curved*, raised below, faint to invisible above, looping and joining near the leaf margin, basal pair short, *without glands in the axils*; intercostal venation reticulate, faintly visible on both surfaces; petiole 1.5–4.5 cm long. *Syconia axillary*, *subglobose*, *1.2–1.5 cm diameter, irregularly wrinkled on drying, apex umbonate.*

Burma, Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. Common in Sabah; rare in Sarawak, known by a single collection, *S. 34786*, from the Dulit Range in Belaga district; in lowland and hill mixed dipterocarp forests, up to 500 m altitude. Also in Brunei and Kalimantan.

145. Leaf margin toothed……………………………….....………..……..**F. tulipifera** (in part)

Leaf margin entire, plane or revolute…………………...…………………….………...146

146. Midrib sunken above……...…………………………...……………...………………..147
Midrib raised or flat above………...………………...……………………………….158

147. Lateral veins flat or raised above…………………...……………………………………
F. laevis Blume
(Latin, *laevis* = smooth; the syconia)
Bijdr. Fl. Ned. Ind. (1825) 437; King *l.c.* (1888) 128; Ridley *l.c.* (1924) 344; Backer & Bakhuizen *f. l.c.* 29; Corner *l.c.* (1965) 53; Kochummen *l.c.* 149; Anderson *l.c.* 259; Whitmore, Tantra & Sutisna *l.c.* 248; Turner *l.c.* 351. Type: *Blume s.n.* (= *RHL Sheet No. 908188162*), Java, Mt. Salak (holotype L). Synonyms: *Pogonotrophe emodi* Wall. *ex* Miq. *l.c.* (1848) 73; *P. emodi* Wall. *ex* Miq. var. *oblongata* Miq. *l.c.* (1859) 330; *P. emodi* Wall. *ex* Miq. var. *cordata* Miq. *l.c.* (1859) 330; *F. subpedunculata* Miq. *l.c.* (1867) 293.
Dioecious climber. *Leaves soft-hairy* or rarely glabrous; ovate or oblong, 12–16 × 9–10 cm, base broadly cuneate or rounded, *margin entire*, *plane*, apex acute; *midrib sunken above*; *lateral veins* up to 5 pairs, raised below, *raised or flat above*; intercostal venation scalariform, faint on both surfaces; petiole 3–7.5 cm long. *Syconia axillary, solitary or in pairs*, globose, 1.5–2.5 cm diameter, glabrous or hairy, apex depressed; *peduncle 1.5–2 cm long*, hairy or glabrous.
India, Sri Lanka, Burma, S China, Indo-China, Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. Rare in Sabah and Sarawak; in lowland and hill mixed dipterocarp forests, up to 1000 m altitude. Not known in Brunei.
Two varieties are recognised in Sabah and Sarawak, viz. var. *laevis* and var. *tomentosa* King. Var. *tomentosa* differs from var. *laevis* by the hairy leaves below.
Lateral veins sunken above……………………...……………………………...148

148. Leaf apex obtuse…………………………………....………………………………149
Leaf apex acute or acuminate……………………...…………………...………..151

149. Lateral veins 7–12 pairs…………………………...…………………...…………………..
F. sarawakensis Corner
(of Sarawak)
Blumea 20 (1972) 427. Type: *Anderson & Ilias S. 28606*, Borneo, Sarawak, Kapit district, Bt. Tibang (holotype CGE; isotype SAR).
Large, *dioecious root-climber*. *Twigs flat*, young ones hairy. Stipules up to 1 cm long, subpersistent. *Leaves sparsely rough hairy on both sides*; lanceolate to elliptic, *9–15 × 2.6–3.8 cm*, *base weakly asymmetric*, cuneate, *margin entire*, *revolute*, *apex obtuse*; *midrib sunken above*; *lateral veins 7–12 pairs*, *sunken above*, *raised below*; *intercostal venation areolate*, *prominent beneath*; *petiole up to 3.5 cm long*. *Syconia crowded on leafless shoots arising from the stem* (young syconium-bearing shoots often persistently and densely stipulate), ripening red, subglobose to ovoid, *c.* 4 × 1 cm, *base tapered into a stalk 0.3–1.2 cm long*, apex acute; peduncle absent or up to 0.5 cm long; basal bracts caducous; internal bristles sparse, white or brownish.
Endemic to Borneo. Confined to Sarawak, where it is widely distributed in lowland mixed dipterocarp to lower montane forests, up to 1300 m altitude.
Lateral veins 4–7 pairs......…………………………......…………………………….…………150

150. Leaf distinctly asymmetric, with auriculate and cordate base on each side................……….

F. ruginervia Corner

(Latin, *ruginervius* = with wrinkled veins; the leaves)

Gard. Bull. Sing. 18 (1960) 24, *l.c.* (1965) 61; Whitmore, Tantra & Sutisna *l.c.* 253; Turner *l.c.* 353; Coode *et al.* (eds.) *l.c.* 217. Type: *Corner SFN 28446*, Peninsular Malaysia, Johore (holotype SING). Synonyms: *F. callicarpa* Miq. var. *crassinervia* Corner *l.c.* (1939) 118.

Dioecious creeper, *with flat stem*. Twigs hairy. *Leaves soft-hairy*; elliptic to obovate, *2–8 × 1–4.7* cm, *base distinctly asymmetric*, *one side auriculate and the other broadly cordate*, *margin entire*, *plane*, *apex obtuse to rounded*; *midrib sunken above*; *lateral veins 3–7 pairs*, *sunken above*; intercostal venation reticulate, distinct below; *petiole 0.3–1 cm long*, hairy. *Syconia on tubercles arising from the stem*, bright red when ripe, subglobose, 4–10 × 3–8.5 cm, *tapered towards the base*; basal bracts tiny, with pointed apex, persistent; peduncle distinct.

Sumatra, Peninsular Malaysia and Borneo. Rare in Sarawak, not yet reported for Sabah. In lowland mixed dipterocarp forest. Also in Brunei and Kalimantan.

Leaf symmetric, base cuneate, rounded or truncate.......…………………...……………………

F. consociata Blume

(Latin, *consociatus* = united, connected; the syconia)

Bijdr. Fl. Ned. Ind. (1825) 447; King *l.c.* (1887) 33; Merrill *l.c.* (1921) 222; Ridley *l.c.* (1924) 331; Burkill *l.c.* 1023; Backer & Bakhuizen *f. l.c.* 34; Corner *l.c.* (1965) 15; Kochummen *l.c.* 144; Anderson *l.c.* 257; Whitmore, Tantra & Sutisna *l.c.* 243; Turner *l.c.* 349; Coode *et al.* (eds.) *l.c.* 213. Type: *Blume s.n.* (= *RHL Sheet No. 908186949*), Java, Mt. Salak (holotype L). Synonym: *Urostigma consociatum* (Blume) Miq. *l.c.* (1854) 91; *F. consociata* Blume var. *murtoni* King *l.c.* (1887) 34, *syn. nov.*

Monoecious climber. Twigs greyish brown, strongly ridged, youngest reddish brown hairy. Stipules lanceolate, *c.* 1.5 cm long, reddish brown hairy, caducous. *Leaves reddish brown soft-hairy below*, *glabrescent*; oblong to narrowly obovate, 7–13 × 3–6 cm, *base symmetric*, *cuneate to rounded or truncate*, *margin entire*, *plane*, *apex obtuse*; *midrib sunken above*; *lateral veins 5–7 pairs*, looping and joining near the leaf margin, raised below, *sunken above*, especially the basal veins, basal pair reaching almost 1/2 the length of the blade; intercostal venation reticulate, distinct below, invisible above;

petiole 0.8–2 cm long, hairy, glabrescent. *Syconia on twigs behind the leaves*, *sessile*, ripening yellow, subglobose, 1–1.2 cm diameter, apex umbonate, surface smooth or faintly wrinkled; basal bracts large and persistent.

Burma, Cambodia, Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. Widely distributed in Sabah and Sarawak; in lowland mixed dipterocarp forest. Also in Brunei and Kalimantan.

151. Leaf base cuneate.…………………………………………….....……………..…...152

Leaf base rounded or subcordate……………………………......……..………………...154

152. Leaves rough hairy below. Syconia solitary, without basal bracts…………..……………..…

F. parietalis Blume

(Latin, *parietalis* = borne on the wall; inference unknown)

Bijdr. Fl. Ned. Ind. (1825) 462; Merrill *l.c.* (1921) 225; Ridley *l.c.* (1924) 330; Masamune *l.c.* 248; Corner *l.c.* (1965) 77; Backer & Bakhuizen *f. l.c.* 25; Kochummen *l.c.* 153; Anderson *l.c.* 260; Whitmore, Tantra & Sutisna *l.c.* 251; Turner *l.c.* 352; Coode *et al.* (eds.) *l.c.* 216. Type: *Blume s.n.* (= *RHL Sheet No. 908188287*), Java, Mt. Parang (holotpe L). Synonyms: *F. cerasiformis* Desf., Cat. Hort. Paris ed. 3 (1829) 413; *F. grandifolia* Wall. *ex* Miq. *l.c.* (1848) 432;

F. phlebophylla Miq. *l.c.* (1867) 293; *F. rufipila* Miq. *l.c.* (1867) 293; *F. tabing* Miq. *l.c.* (1867) 293.

Dioecious climber. Twigs yellowish, angled, youngest reddish brown hairy. Stipules lanceolate, *c.* 0.5 cm long, *reddish brown hairy*, caducous. *Leaves* glabrous above, *rough hairy below*; oblong or elliptic, 9–28 × 3.8–10 cm, *base cuneate*, *margin entire*, *plane*, *apex acuminate*, acumen 1 cm long or more; *midrib sunken above*; *lateral veins* 4–5 pairs, steeply ascending, raised below, *sunken above*, basal pair reaching more than 1/2 the length of the blade; intercostal venation scalariform, raised below, faint above; petiole 0.5–1.5 cm long, sparsely hairy. *Syconia solitary*, *axillary*, ripening orange, *rough hairy*, globose, 0.7–1.3 cm diameter, *without basal bracts*; *peduncle 1–1.5 cm long*.

Indo-China, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines. Widely distributed in Sabah and Sarawak; in lowland and hill mixed dipterocarp forests, including peatswamp forest, usually by streams. Also in Brunei and Kalimantan.

Leaves soft-hairy below. Syconia in clusters, with persistent basal bracts.....………...…..153

153. Stipules caducous…………………………...…………………………...……….…..

F. supperforata Corner (in part)

(meaning and inference unclear)

Gard. Bull. Sing. 18 (1960) 16, *l.c.* (1965) 57; Whitmore, Tantra & Sutisna *l.c.* 257; Coode *et al.* (eds.) *l.c.* 218. Type: *Mondi 29*, Borneo, Kalimantan, Pontianak (holotype L).

Dioecious climber. Twigs 0.2–0.3 cm thick, hairy. *Stipules* hairy, *caducous*. *Leaves* thick-coriaceous, *sparsely soft-hairy below*; elliptic, 9–18 × 4–8 cm, *base cuneate* or narrowly subcordate, *margin entire*, *plane*, *apex acute*; *midrib sunken above*; *lateral veins* 5–7 pairs, *sunken above*, raised below, with a number of shorter intermediate veins in between, basal pair reaching to 1/3–1/2 the length of the blade; intercostal venation minutely reticulate; petiole 1.2–3 cm long, appressed hairy. *Syconia axillary or borne on twigs behind the leaves*, *in fascicles of 2–6*, minutely hairy, *sessile*, *tapered at the base into a stalk 0.4–0.6 cm long*, subglobose, 0.7–0.9 cm diameter, apex depressed; *basal bracts persistent*.

Endemic to Borneo. Very rare in Sarawak, known by 4 collections from peatswamp forest; not yet reported for Sabah. Also in Brunei.

Stipules persistent……………….………………………...………………………………...

F. spiralis Corner

(Latin, *spiralis* = spiral; the slender stems spiralling around the supporting trunk of host tree)

Gard. Bull. Sing. 18 (1960) 13, *l.c.* (1965) 56. Type: *Purseglove 4642*, Borneo, Sarawak, Lundu district, Semantan, Kg. Pueh (holotype CGE).

Dioecious climber. Twigs densely reddish brown hairy. *Stipules* lanceolate, 1.2–3 cm long, hairy, *persistent*. *Leaves* rigid-chartaceous, *pale glaucous and sparsely soft-hairy below*; elliptic to obovate, 28–42 × 8–14 cm, *base cuneate*, *margin entire*, *plane*, *apex acute*; *midrib sunken above*; *lateral veins* 10–14 pairs, raised below, *sunken above*, curving and joining near the leaf margin; intercostal venation scalariform, raised below, *sunken above*; petiole 1–2 cm long, densely reddish brown hairy. *Syconia subsessile*, *in clusters*, *axillary*, depressed globose, 0.6–0.7 cm diameter, reddish brown hairy; *basal bracts persistent*.

Endemic to Borneo. Confined to Sarawak and reported for Kapit, Kuching, Lundu, and Miri (G. Mulu NP) districts. In lowland mixed dipterocarp forest by streams.

154. Stipules persistent……………………………......…………..…………………………...

F. villosa Blume (in part)

(Latin, *villosus* = shaggy with fairly long soft straight hairs; the vegetative parts of the plant)

Bijdr. Fl. Ned. Ind. (1825) 441; Miquel *l.c.* (1848) 451; Merrill *l.c.* (1921) 228; Ridley *l.c.* (1924) 345; Masamune *l.c.* 251; Corner *l.c.* (1965) 56; Backer & Bakhuizen *f. l.c.* 22; Kochummen *l.c.* 161; Whitmore, Tantra & Sutisna *l.c.* 259; Turner *l.c.* 355. Type: *Blume s.n.* (= *RHL Sheet No. 908188153*), Java, Mt. Salak (holotype L). Synonyms: *F. barbata* Wall. *ex* Miq. *l.c.* (1848) 441; *F. hirsuta* Wall. *ex* Miq. *l.c.* (1859) 317.

Dioecious climber. *Stem*, *twigs*, *stipules*, *petioles and undersurface of leaves densely reddish brown*, *woolly or appressed soft-hairy*. *Stipules* oblong, *c.* 3 cm long, *persistent*. *Leaves* ovate to lanceolate, 11–20 × 4.5–9 cm, *base rounded to subcordate*, *margin entire*, *plane*, *apex acute*; *midrib sunken above*, often densely hairy in young leaves; *lateral veins* 5–6 pairs, raised below, *sunken above*, looping and joining near the leaf margin; *intercostal venation* scalariform, raised below, *sunken above*; petiole 1.2–2 cm long. *Syconia on twigs behind the leaves, or borne on branches or stem*, obovoid or subglobose, 0.6–1.2 × 0.6–1 cm, smooth, apex umbonate or not; *peduncle up to 0.5 cm long*; *basal bracts absent*.

Andaman Islands, Assam, Burma, Indo-China, Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. Very rare in Sabah and Sarawak; in lowland and hill mixed dipterocarp forests, up to 1200 m altitude. Also in Kalimantan.

Three varieties are recognised, viz. var. *adpressa* Corner (*l.c.* 18 (1960) 12), var. *subglobosa* Corner (*l.c.* 18 (1960) 13), and var. *villosa*. Var. *adpressa* differs from var. *subglobosa* and var. *villosa* by its appressed hairs on the midrib and petiole. Var. *subglobosa* differs from var. *villosa* by its smaller, subglobose, non-umbonate syconia.

Stipules caducous….…………………….....………………………..………………………155

155. Leaf margin revolute…………………......……………………..……………………………..

F. grossivenis Miq.

(Latin, *grossus* = thick, coarse, *vena* = vein; the coarsely veined leaves)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 227; Merrill *l.c.* (1921) 224; Masamune *l.c.* 246; Corner *l.c.* (1965) 55; Whitmore, Tantra & Sutisna *l.c.* 246; Coode *et al.* (eds.) *l.c.* 215. Type: *De Vriese s.n.* (= *RHL Sheet No. 9081881299*), Maluku, Seram (L). Synonyms: *F. propinqua* Merr., Publ. Govt. Lab. Philip. 29 (1905) 8; *F. lagunensis* Merr., Philip. J. Sc. 9 (1914) Bot. 273; *F. jaroensis* Merr. *l.c.* (1914) 268.

Large, *dioecious*, *woody climber*. Young stem and twigs covered with long brown soft hairs. *Stipules caducous*. *Leaves soft-hairy below*; ovate to elliptic, 10.5–20 × 4.5–10 cm, *base rounded*, *margin entire*, *revolute*, *apex acute*; *midrib sunken above*; *lateral veins* 5–8 pairs, raised below, *sunken above,* basal pair short; *intercostal venation sunken above*; *petiole* 1–3 cm long, *covered with long soft hairs. Syconia axillary*, subglobose, 0.7–1 cm diameter, smooth; peduncle *c.* 0.5 cm long; basal bracts caducous.

Borneo, the Philippines, Sulawesi, and Maluku. Very rare in Sabah and Sarawak, known from Sabah by *SAN A 4447* from Keningau district, and from Sarawak by *S. 50508* from Bario; in hill to lower montane forests, at 900–1200 m altitude. Also in Brunei and Kalimantan.

Leaf margin plane…………………………………...………...………….……………156

156. Syconia in pairs, glabrous, not tapered towards the base……..………………………………

F. forstenii Miq. (in part)

(E.A. Forsten, 1811–1843, zoologist and elected member of the Commission for Natural Sciences for the Dutch East Indies)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 214; King *l.c.* (1887) 29; Merrill *l.c.* (1921) 223; Corner *l.c.* (1965) 16; Kochummen *l.c.* 147; Whitmore, Tantra & Sutisna *l.c.* 245; Turner *l.c.* 350. Type: *Forsten s.n.* (= *RHL Sheet No. 908186979*), Sulawesi, Tondano (holotype L). Synonym: *F. palawanensis* Merr., Publ. Govt. Lab. Philip. 29 (1905) 11.

var. **villosa** Corner

(Latin, *villosus* = shaggy hairy; the lower leaf surface)

Gard. Bull. Sing. 17 (1960) 385, *l.c.* (1965) 16; Kochummen *l.c.* 147; Anderson *l.c.* 259; Whitmore, Tantra & Sutisna *l.c.* 245; Turner *l.c.* 350. Type: *Endert 3344*, Borneo, Kalimantan, W Kutai (holotype L).

Monoecious climber. Twigs grey-brown, irregularly wrinkled, finely hairy. Stipules lanceolate, *c.* 1.5 cm long, *caducous*, appressed hairy outside. *Leaves* shining above, *soft-hairy below*; oblong, *c.* 21 × 11 cm, *base rounded or subcordate*, *margin entire*, *plane*, *apex acute*; *midrib sunken above*; *lateral veins* 8–10 pairs, *sunken above*, raised below, distinctly looping near the leaf margin; petiole 2–2.5 cm long, sparsely hairy. *Syconia sessile, in pairs, glabrous, not tapered towards the base*; basal bracts persistent.

Peninsular Malaysia, Borneo and the Philippines. In Borneo, so far recorded only for Sabah; in lowland mixed dipterocarp forest.

Syconia in clusters, glabrous or hairy, base tapered…………………………………..…..…157

157. Lateral veins faintly sunken above……………………….................**F. supperforata** (in part)

Lateral veins distinctly sunken above………………...………...…………………………..……

F. lanata Blume

(Latin, *lanatus* = clothed with woolly hairs; the twigs, petiole and leaf under surface)

Bijdr. Fl. Ned. Ind. (1825) 441; Miquel *l.c.* (1867) 294; King *l.c.* (1888) 137; Corner *l.c.* (1965) 57; Backer & Bakhuizen *f. l.c.* 23; Whitmore, Tantra & Sutisna *l.c.* 248; Coode *et al.* (eds.) *l.c.* 215. Type: *Blume s.n.* (= *RHL Sheet No. 908188153*), Java, Mt. Salak (holotype L).

Dioecious climber. *Twigs, petioles and leaf undersurface densely soft-hairy*. *Stipules caducous*. *Leaves* ovate or lanceolate, 12.5–19 × 5.5–8.5 cm, *base rounded*, *margin entire*, *plane*, *apex acute*; *midrib sunken above*; *lateral veins* 4–6 pairs, raised below, *distinctly sunken above*, basal pair reaching more than 1/2 the length of the blade; intercostal venation scalariform, raised below, invisible above; petiole 1–1.5 cm long, hairy. *Syconia in clusters*, *axillary*, subglobose, 0.4–0.7 cm diameter, apex perforated, *base tapered into a stalk*; peduncle absent.

Sumatra, Borneo and Java. In hill to lower montane forests, at 800–1600 m altitude. Also in Brunei and Kalimantan.

Two varieties are recognised in Sabah and Sarawak, namely var. *foveolata* Corner (*l.c.* 18 (1960) 16) and var. *lanata*. The former differs from the latter by its minutely pitted leaf undersurface.

158. Petiole 0.2–0.4 cm long. Leaves cordate or auriculate at the base………….………………..

F. barba-jovis Corner

(Latin, *barba* = beard, *jovis* = latinised spelling for Jupiter; bearded with tufts of long weak hairs resembling that of Jupiter's beard; the syconia)

Gard. Bull. Str. Settl. 10 (1939) 102, *l.c.* (1965) 62; Whitmore, Tantra & Sutisna *l.c.* 24. Type: *Carr SFN 27305*, Borneo, Sabah, Mt. Kinabalu, near Kg. Koung (holotype SING).

Dioecious root-climber. *Young twigs, petioles and leaf blades sparsely rough-hairy*. Stipules lanceolate, 0.4–1 cm long, finely appressed hairy. Leaves elliptic or lanceolate, 2–8.5 × 1–3.5 cm, *base strongly asymmetric, cordate to auriculate on one side and cuneate on the other side, margin entire, plane*, apex acute; *midrib flat or faintly raised above*; lateral veins 6–9 pairs, raised below, faint to invisible above, arching and joining near the leaf margin to form distinct intramarginal vein; intercostal venation reticulate, distinctly visible below; *petiole 0.2–0.4 cm long*, brown hairy. *Syconia solitary, arising from short woody tubercles on the stem*, rose-pink when ripe, *densely hairy*, ellipsoid, *c.* 7 × 5 cm, apex incompletely closed; peduncle *c.* 0.5 cm long, hairy; basal bracts 3, triangular, acute.

Endemic to Borneo. Very rare, known only from Mt. Kinabalu in Sabah; in hill mixed dipterocarp forest, at about 500 m altitude.

Petiole (0.2–)0.7–2(–4.8) cm long. Leaves not cordate or auriculate at the base………....159

159. Lateral veins sunken above……………………………………………...………………...160

Lateral veins flat or raised above…………………………………..…….…………..162

160. Leaf margin revolute. Syconia *c.* 7.5 × 5 cm………………………….….…………………..

F. carri Corner

(C.E. Carr, 1892–1936; sometime manager of rubber plantations in Malacca and Pahang, Peninsular Malaysia)

Gard. Bull. Str. Settl. 10 (1939) 123, *l.c.* (1965) 62; Whitmore, Tantra & Sutisna *l.c.* 242. Type: *Carr SFN 27839*, Borneo, Sabah, Mt. Kinabalu, Bundu Tuhan (holotype SING).

Dioecious root-climber, with greyish white stem. *Leaves* thick-coriaceous, *reddish brown soft-hairy below*; elliptic to lanceolate or ovate-lanceolate, 10–21 × 4.8–9 cm, *base rounded*, *symmetric*, *margin entire*, *revolute*, apex acute; *midrib flat above*; *lateral veins* 6–10 pairs, looping and joining near the leaf margin, raised below, *sunken above*; *intercostal venation reticulate, sunken above*; *petiole 2.5–4.8 cm long*, brown-hairy. *Syconia axillary or borne on short woody tubercles arising from the stem*; ellipsoid, *c. 7.5 × 5 cm*, with distinct neck, ripening olive-brown to purplish brown, *velvety white-hairy*, surface rugose, apex depressed, base narrowed into a short stalk; peduncle 0.2–0.3 cm long; basal bracts 3.

Endemic to Borneo, restricted to Mt. Kinabalu in Sabah; in lower montane forest, at 200–1700 m altitude.

Leaf margin plane. Syconia up to 1 cm long……………………….…………..….………161

161. Indumentum comprising hairs with hook-like tips. Syconia-bearing branches not hanging down………………………………………..…………..………..

F. uncinulata Corner

(Latin, *uncinulatus* = set with fine hooks or barbs; the leaves, twigs and syconia)

Gard. Bull. Sing. 18 (1960) 15, *l.c.* (1965) 56; Kochummen *l.c.* 160; Whitmore, Tantra & Sutisna *l.c.* 258; Turner *l.c.* 355; Coode *et. al.* (eds.) *l.c.* 219. Type: *van Steenis 1156*, Borneo, Kalimantan, Natuna Island, G. Ranai (holotype L).

Dioecious climber. *Twigs, leaves and syconia pubescent with hook-like hairs*. Twigs 2–2.5 cm thick, brown. Stipules lanceolate, up to 1 cm long, soft-hairy. *Leaves sparsely* *soft-hairy on midrib and veins above*, *densely soft-hairy below*; ovate, elliptic or lanceolate, 9.5–18 × 3–8 cm, *base broadly cuneate*, *margin entire*, *plane*, apex acute; *midrib raised above*; *lateral veins* 4–5 pairs, with a number of short intermediate veins in between, distinct below, *sunken above*, basal pair reaching more than 1/2 the length of the blade; intercostal venation reticulate, visible below, faint above; *petiole 0.7–1.5 cm long*, hairy. *Syconia borne on twigs behind the leaves*, *in pairs or in fascicles*, subglobose, *0.7–0.9 cm diameter*, with depressed apex, base narrowed into a stalk 0.2–0.9 cm long.

Peninsular Malaysia and Borneo. Rare, but locally frequent in Sabah and Sarawak, especially on Mt. Kinabalu. In lowland to hill mixed dipterocarp forests, up to 1000 m altitude. Also in Brunei and Kalimantan.

Hairs straight. Syconia-bearing branches hanging down………………….………………...

F. pendens Corner

(Latin, *pendens* = hanging down from its support; the syconia-bearing branches)

Gard. Bull. Sing. 18 (1960) 15, *l.c.* (1965) 57; Kochummen *l.c.* 153; Whitmore, Tantra & Sutisna *l.c.* 252; Turner *l.c.* 353. Type: *Purseglove 4168*, Peninsular Malaysia, Pahang, Fraser's Hills (holotype SING).

Dioecious, *slender climber*. *Syconia-bearing branches hanging down. Twigs*, *leaves and syconia densely covered with reddish brown*, *rigid*, *straight hairs*. *Leaves* glabrous above, *hairy below*; ovate, elliptic or lanceolate, 4.5–15 × 1.8–7 cm, *base subcordate or cuneate*, *margin entire*, *plane*, apex acute; *midrib raised above*; *lateral veins* 3–7 pairs, raised below, *sunken above*, basal pair reaching to 1/2 the length of the blade; *petiole 0.2–1.5 cm long*, hairy. *Syconia axillary*, *in fascicles*, *sessile or subsessile*, subglobose, *0.5–0.6 cm diameter*, apex depressed, base sometimes narrowed into a stalk up to 0.1 cm long.

Sumatra, Peninsular Malaysia and Borneo. Very rare in Sabah and Sarawak, recorded for Mt. Kinabalu in Sabah, and Kuching district in Sarawak only. In hill mixed dipterocarp and lower montane forests, up to 1300 m altitude. Not known in Brunei.

162. Leaf base broadly cuneate………………………………….…...…………………………..

F. urnigera Miq.

(Latin, *urna* = urn or a water-pot, *-ger* = bearing; with pitcher-shaped syconia)

In Zollinger, Syst. Verz. 2 (1854) 92, *l.c.* (1859) 318; Corner *l.c.* (1965) 55; Kochummen *l.c.* 160; Whitmore, Tantra & Sutisna *l.c.* 259; Coode *et al.* (eds.) *l.c.* 219. Type: *Zollinger s.n.* (= *RHL Sheet No. 9081882002*), Java, Bogor (holotype L). Synonyms**:** *F. recurva* Blume var. *urnigera* (Miq.) King *l.c.* (1888) 132; *F. ramentacea* Roxb. var. *urnigera* (Miq.) Backer, Bekn. Pl. Java (em. ed.) 6 (1948) 23.

Dioecious climber. Twigs dark brown to reddish brown, slightly grooved. *Stipules* lanceolate, *velvety hairy*, caducous. *Leaves* drying chocolate-brown, *sparsely soft-hairy on the lower surface*, sometimes also on the upper surface; ovate or elliptic, 6.5–10.5 × 5.5 cm, *base broadly cuneate*, *margin entire*, *plane*, apex acute; *midrib raised above*; *lateral veins* 3–4 pairs, raised below, *flat above*, with few short intermediate veins in between, basal pair reaching more than 1/2 the length of the blade; intercostal venation scalariform, visible below, invisible above; *petiole 0.5–1.2 cm long*, sparsely hairy. *Syconia borne on twigs behind the leaves*, subglobose to urceolate, *c.* 0.5 cm diameter, flat and depressed at the apex; *basal bracts* large, persistent, *covered with long hairs*.

Lower Burma, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, and the

Philippines. Very rare in Sabah and Sarawak, known by one collection each, *SAN 127816*, from Penampang district in Sabah, and *S. 45685* from Kuching district in Sarawak; in lowland and hill mixed dipterocarp forests. Also in Brunei and Kalimantan.

Leaf base rounded or subcordate……………….……....…………...……………………..163

163. Stipules persistent……………………………….....…………..……..**F. villosa** (in part)

Stipules caducous……………………………....……….………...…………………164

164. Leaf apex acute……………………………….....……………………..**F. recurva** (in part)

Leaf apex usually obtuse…………………....……………..………...……………………

F. trichocarpa Blume

(Greek, *tricho* = hairy, *karpos* = fruit; the hairy syconia)

Bijdr. Fl. Ned. Ind. (1825) 458; Corner *l.c.* (1965) 59; Backer & Bakhuizen *f. l.c.* 22; Kochummen *l.c.* 159; Whitmore, Tantra & Sutisna *l.c.* 257; Turner *l.c.* 355. Type: *Blume s.n.*, Java, Mt. Pangrango (holotype L?). Synonyms: *F. filiformis* Blume *l.c.* 442; *Pogonotrophe piperifolia* Miq. *l.c.* (1854) 93; *P. borneensis* Miq. *l.c.* (1859) 330; *F. piperifolia* (Miq.) Miq. *l.c.* (1867) 293; *F. piperifolia* var. *borneensis* (Miq.) Miq. *l.c.* (1867) 293.

Dioecious climber. Twigs glabrous or hairy. *Stipules* lanceolate, glabrous or rusty velvety hairy, *caducous*. *Leaves rough-hairy on both surfaces or soft hairy below*; ovate, obovate or oblong, 6–17 × 3–9 cm, *base* often asymmetric, *rounded to subcordate* or rarely cuneate, *margin entire*, *plane*, *apex rounded or obtuse*, rarely acute; *midrib flat above*; *lateral veins* 4–7 pairs, *raised on both surfaces*; intercostal venation scalariform to reticulate, distinct below, faint above; *petiole 1–2 cm long*, glabrous or hairy. *Syconia borne on twigs behind the leaves*, subglobose, 0.7–1 cm diameter, velvety hairy to glabrous, apex umbonate; basal bracts persistent; peduncle 0.5–1 cm long.

Indo-China, Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. Rare in Sabah and Sarawak; in lowland and hill mixed dipterocarp forests, mainly by streams. Also in Kalimantan.

Two varieties are recognised in Sabah and Sarawak, viz. var. *piperifolia* Corner (*l.c.* 18 (1960) 19) and var. *trichocarpa*. The former can be distinguished from the latter by its thinly appressed hairy leaves with acute apex, and its larger syconia.

165. Midrib forked…………………………...…….……………....……….……………………..166

Midrib not forked…………………………………………....…….……………...……167

166. Lateral veins 4–5 pairs. Syconia hairy……………………..……………………….……...….

F. deltoidea Jack var. **subhirsuta** Kochummen

(Latin, *deltoideus* = deltoid, equilateral-triangular, the leaves; *subhirsutus* = covered with somewhat coarse and stiff long erect hairs; the syconia)

Gard. Bull. Sing. 50 (1998) 214. Type: *Yii S. 48452*, Borneo, Sarawak, Kapit district, Batang Baleh (holotype KEP; isotype SAR).

Dioecious epiphyte. Twigs dark brown, scaly. Leaves sparsely yellowish hairy below; obovate, 2.2–3.5 × 1.7–2 cm, base attenuate, margin entire, plane, *apex rounded*; *midrib forked near the apex*; *lateral veins 4–5 pairs*, curving and joining near the leaf margin, distinct below, faint above; petiole 0.3–0.6 cm long. *Syconia axillary, solitary*, red when ripe, ellipsoid, *c.* 0.3 × 0.2 cm, *rough-hairy*; peduncle *c.* 0.2 cm long; basal bracts persistent, hairy.

Endemic to Borneo, very rare, known only by the type collection from Sarawak. In hill mixed dipterocarp forest, at *c.* 900 m altitude.

Lateral veins 1–2 pairs. Syconia usually glabrous, very rarely hairy...................………………

F. deltoidea Jack var. **recurvata** Kochummen

(Latin, *recurvatus* = recurved; the leaf margin)

Gard. Bull. Sing. 50 (1998) 213. Type: *Othman et al. S. 48969*, Borneo, Sarawak, Bintulu district, Tubau (holotype KEP; isotypes SAN, SAR).

Dioecious epiphyte. Leaves thick-coriaceous; deltoid, 7.5–12 × 4–10 cm, base attenuate, *margin entire*, *revolute*, apex rounded; *midrib forked*, *sunken above on the lower half*; *lateral veins 1 pair*; intercostal venation reticulate, visible below, invisible above; petiole 1–3 cm long, channelled on the adaxial side. *Syconia glabrous*, black on drying, subglobose, *c.* 1.2 cm diameter, apex umbonate; peduncle short.

Endemic to Borneo. Confined to Sarawak, so far recorded for Bintulu and Kuching districts. In lower montane forest.

167. Leaves hairy below.........……………………………………..………....……………………

F. bracteata (Wall. *ex* Miq.) Miq.

(Latin, *bracteatus* = with bracts; the syconia)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 285; King *l.c.* (1887) 23; Merrill *l.c.* (1921) 221; Ridley *l.c.* (1924) 331; Burkill *l.c.* 1021; Masamune *l.c.* 243; Corner *l.c.* (1965) 15; Kochummen *l.c.* 141; Whitmore, Tantra & Sutisna *l.c.* 242. Basionym: *Urostigma bracteatum* Wall. *ex* Miq. *l.c.* (1847) 576. Type: *Wall. Cat. 4498*, Penang (K?).

Monoecious epiphyte, *with free hanging aerial roots*. Twigs yellowish, irregularly angled, youngest reddish brown hairy. Stipules ovate or lanceolate, 2–3 cm long, densely reddish brown hairy. *Leaves reddish brown hairy below*; oblong, 15–20 × 7–10 cm, base subpeltate, rounded to subcordate, margin entire, plane, apex cuspidate; *midrib not forked*, *sunken above*; *lateral veins* 8–9 pairs, raised below, *sunken above*, looping and joining near the leaf margin to form distinct intramarginal vein, basal pair reaching about 1/3 the length of the blade; intercostal venation reticulate, raised below, almost invisible above; petiole 1.5–2 cm long, reddish hairy. *Syconia axillary, subtended by lanceolate*, *acuminate persistent bracts*, *sessile*, covered with brown hairs, globose, *c.* 1.2 cm diameter (immature), wrinkled, apex with prominent disc; basal bracts large with blunt apices, persistent; *internal bristles abundant*.

Sumatra, Peninsular Malaysia and Borneo. Very rare in Borneo, known only by a single collection, *S. 34097*, from Lubok Antu district in Sarawak. In lowland mixed dipterocarp forest by rocky streams.

Leaves glabrous on both surfaces..…………………………...………...………………168

168. Leaf margin lobed……………………………..……………..........……………………..

F. deltoidea Jack var. **motleyana** (Miq.) Corner (in part)

(James D. Motley, ?–1859 engineer and plant collector, mainly in Borneo)

Gard. Bull. Sing. 17 (1960) 424, *l.c.* (1965) 38, *l.c.* (1969) 308; Kochummen *l.c.* 145; Whitmore, Tantra & Sutisna *l.c.* 244; Coode *et al.* (eds.) *l.c.* 214. Basionym: *F. motleyana* Miq. *l.c.* (1867) 228. Type: *De Vriese s.n.* (= *RHL Sheet No. 9081881866*), Borneo (isotype L). Synonym: *F. landonii* Sym., J. Mal. Br. Roy. As. Soc. 14 (1936) 359.

Dioecious epiphyte. *Twigs crooked*. *Leaves glabrous*; elliptic to lanceolate, 5.5–18 × 2–6 cm, base cuneate, *margin distinctly lobed*, *apex acuminate*; *midrib not forked*, *sunken above*; lateral veins 4–5 pairs, faint above; intercostal venation reticulate, *equally* *prominent as lateral veins below*; petiole 0.5–3 cm long. Syconia oblong, 1–2 × 0.5–1 cm, with short peduncles.

Peninsular Malaysia, Sumatra and Borneo. Common in Sabah and Sarawak. Also in Brunei and Kalimantan. In lowland swampy forest and in limestone habitats.

Leaf margin entire, plane or revolute……………………………...……….……………...169

169. Leaf without glands in the axils of basal lateral veins…………..………….…………...

F. acamptophylla Miq.

(Greek, *akamptos* = stiff, *phullon* = leaf; with stiff leaves)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 264; King *l.c.* (1887) 40; Merrill *l.c.* (1921) 220; Ridley *l.c.* (1924) 335; Masamune *l.c.* 242; Corner *l.c.* (1965) 20; Whitmore, Tantra & Sutisna *l.c.* 239; Coode *et al.* (eds.) *l.c.* 211. Basionym: *Urostigma acamptophyllum* Miq. *l.c.* (1860) 439. Type: *Teijsmann HB 3457*, Sumatra, Bangka (holotype U; isotype L). Synonym: *F. pachyphylla* King *l.c.* (1887) 32.

Monoecious epiphyte. Young twigs purplish hairy at first, becoming glabrous, angled. Stipules *c.* 1 × 0.4 cm, hairy outside. *Leaves thick-coriaceous*, *glabrous*, *faintly glaucous below*, drying chocolate-brown; oblong, oblanceolate or narrowly obovate, 4–12 × 1.8–6 cm, base rounded or broadly wedge-shaped, *margin entire*, *distinctly revolute*, apex rounded or obtuse; *midrib not forked*, *sunken above*; *lateral veins* 7–8 pairs, *joining near the leaf margin to form looped intramarginal vein*, distinct below, faint above, *without glands in the axils of basal pair*; intercostal venation reticulate, visible on both surfaces; petiole 0.5–1.5 cm long. *Syconia borne on twigs behind the leaves*, pale orange when ripe, *usually in pairs*, *sessile*, subglobose to oblong, 0.8–1 cm diameter, slightly wrinkled, apex umbonate, with an ostiole; basal bracts ovate, acute, persistent.

Sumatra, Borneo and St. Barbe Is. Rare in Sabah, widely distributed in Sarawak; in lowland forest, including beach, swamp, *kerangas* and secondary forests. Also in Brunei and Kalimantan.

Leaf with glands in the axils of basal lateral veins below……….…………………..…….170

170. Leaves elliptic, apex acute. Syconia oblong to subglobose…….….…………………….…

F. oleifolia King var. **impressicostata** Kochummen

(Latin, *oleifolius* = with leaves like that of olive tree—*Olea*, Oleaceae, *impressus* = sunken, *costa* = midrib; the leaves with impressed midrib)

Gard. Bull. Sing. 50 (1998) 216. Type: *Ilias S. 40961*, Borneo, Sarawak, Kapit district, Melinau (holotype KEP; isotypes SAN, SAR).

Dioecious epiphyte. *Leaves glabrous*, *elliptic*, base cuneate, *margin entire and plane*, *apex acute*; *midrib not forked, sunken above*; *lateral veins very faint to invisible*, basal pair with 1–2 glands in each axil below; petiole 0.2–0.3 cm long. *Syconia oblong to subglobose*, 0.3–0.4 cm diameter; peduncle 0.5–0.8 cm long.

Endemic to Borneo. Reported for Sarawak only. Rare, known by 2 collections, *S. 21943* and *S. 37304*, from Melinau, Kapit district. In hill mixed dipterocarp to lower montane forests, at 700–1300 m altitude.

Leaves narrowed obovate, apex rounded. Syconia globose……………….…….………...........

F. oleifolia King var. **dodonaeifolia** (Gagnep.) Corner

(Latin, *dodonaefolius* = with leaves resembling those of *Dodonaea*, Sapindaceae)

Gard. Bull. Sing. 17 (1960) 425, *l.c.* (1965) 38; Whitmore, Tantra & Sutisna *l.c.* 251; Coode*et al.* (eds.) *l.c.* 216.

Basionym: *F. dodonaeifolia* Gagnep., Not. Syst. 4 (1927) 90. Type: unknown.

Dioecious epiphyte. *Leaves glabrous*, *sessile or with petiole 0.2–0.3 cm long*; *narrowly obovate*, 2–5 × 0.4–0.8 cm, base attenuate, *margin entire*, *revolute*, *apex rounded*; *midrib not forked*, *sunken above*; lateral veins invisible to very faintly visible below, basal pair with 1–2 glands in each axil below. *Syconia axillary or borne on twigs behind the leaves*, *globose*, 0.3–0.4 cm diameter, apex umbonate; peduncle 1–1.5 cm long.

Endemic to Borneo; recorded for Sarawak only, where it is widely distributed. In lowland to hill mixed dipterocarp forests, including *kerangas* forest, up to 1200 m altitude.

1. **Ficus albipila** (Miq.) King

(Latin, *albus* = white, *pilus* = hairs; the whitish hairs on the twigs and leaves)

Ann. Roy. Bot. Gard. Calc. 1, 2 (1888) 179; Corner *l.c.* 17 (1960) 408, *l.c.* (1965) 29; Backer & Bakhuizen *f. l.c.* 30; Kochummen *l.c.* 139; Whitmore, Tantra & Sutisna *l.c.* 239; Turner *l.c.* 348. **Basionym:** *Covellia albipila* Miq. *l.c.* (1861) 434. **Type:** *Teijsmann HB 3545* (= *UH Sheet No. 47547 B*), Sumatra, Palembang, Muaradua (holotype U). **Synonyms:** *Morus leucophylla* Miq. *l.c.* (1861) 415; *F. mollis* Miq. var. *albipila* (Miq.) Miq. *l.c.* (1867) 296; *F. mallotoides* Valeton *ex* Backer, Blumea 6 (1948) 304; *F. microtricherinos* Backer, Bekn. Fl. Java 6 (1948) 40; *F. albipila* (Miq.) King var. *glabra* Corner *l.c.* 17 (1960) 408, Whitmore, Tantra & Sutisna *l.c.* 239; type: *Motley 613*, Borneo, Banjarmasin (CGE), *syn. nov.*

Monoecious deciduous tree, *up to 40 m tall*; *buttresses up to 6 m high*. **Bark** *whitish*, *smooth* resembling that of *Koompassia excelsa* (Leguminosae). **Twigs** 0.2–0.4 cm thick, *whitish hairy*. **Stipules** 0.6–1.2 cm long, densely appressed hairy, free, paired. **Leaves** *spirally arranged*, thin-coriaceous, *drying yellowish brown*, *sparsely whitish hairy below*; lanceolate, 8–10 × 3.5–5 cm, *base symmetric*, broadly cuneate to truncate, *margin entire*, *plane*, apex acute; *midrib raised above*; lateral veins *c*. 10 pairs, with short veins in between, faint but visible on both surfaces, basal veins 2–4 pairs, short, departing at a broad angle from the midrib, *without a gland in each axil below*; intercostal venation reticulate, faint on both surfaces; petiole slender, 3.5–5.5 cm long. **Syconia** *paired or solitary, axillary or borne on twigs behind the leaves*, ripening yellow to pink and red, depressed globose, 1–1.5 cm across, densely to sparsely whitish hairy; *peduncle up to 0.8 cm long*; basal bracts 3, ovate, obtuse, 1–1.5 mm long, appressed hairy, caducous; internal bristles abundant. **Tepals** 4–7, free, red, glabrous. **Achenes** ellipsoid, *c*. 1.2 mm long, smooth, with small ridge along the styles side.

Distribution. S India, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, Lesser Sunda Islands, New Guinea, New Britain, New Ireland, and Queensland, Australia. In Borneo extremely rare (probably not collected because of its large size). So far known only by a single collection, *Reza Azmi RA 75*, from Sg. Resang near Kg. Sukau, Kinabatangan district, in Sabah, and from Banjarmasin in Kalimantan.

Ecology. In lowland forest by streams. This tree is a nesting place for honey bees, just like *Koompassia excelsa*, with which it shares similarity in external bark features and height.

2. **Ficus androchaete** Corner

(Greek, *andro* = male, *chaete* = long hair; the hairy stamens)

Gard. Bull. Sing. 17 (1960) 438, *l.c.* (1965) 49; Anderson *l.c.* 256; Primack *l.c.* 71; Whitmore, Tantra & Sutisna *l.c.* 240; Coode *et al.* (eds.) *l.c.* 211. **Type:** *Corner BRUN 5320*, Borneo, Brunei, Amo, Ulu Belalong (holotype CGE).

Dioecious tree, up to 10 m tall, 10 cm diameter. **Twigs** 0.3–0.4 cm thick, dark brown, slightly angled, with distinct stipular scars. **Stipules** lanceolate, acute, *c.* 0.6 × 0.1 cm, *brownish hairy outside*. **Leaves** *spirally arranged*, coriaceous, *sparsely brownish rough-hairy on both surfaces*; oblong or obovate, 11–26 × 3.5–9.5 cm, base wedge-shaped or broadly rounded, *margin entire*, *plane*, apex acuminate, acumen 1–1.5 cm long; *midrib flat above*; lateral veins 4–6 pairs, with shorter veins in between, curving and joining near the leaf margin to form intramarginal vein, basal pair reaching up to 1/2 the length of the blade, departing at an acute angle from the midrib, *with a hairy gland in each axil below*; intercostal venation reticulate, visible above, distinct below; petiole 2–6.5 cm long, *brownish rough-hairy*, drying yellowish and wrinkled. **Syconia** *axillary*, ripening yellow to dark orange, pear-shaped, 0.8–1.4 × 0.8–1.1 cm, apex umbonate; *peduncle* slender, *0.8–1.1 cm long*, with tiny persistent bracts at its apex; basal bracts ovate, 2–3 mm long; internal bristles numerous, up to 1.5 mm long. **Tepals** 3–4, white, *brownish hairy*. **Achenes** *c.* 1.3 mm long, tuberculate, keeled.

Vernacular names. Sarawak—*kumpan* (Iban), *lunok* (Murut).

Distribution. Endemic to Borneo. Rare with localised distribution in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, up to 1000 m altitude, mainly by streams.

3. **Ficus ashtonii** Kochummen

(P.S. Ashton, 1934–, sometime forest botanist at the Forestry Departments of Brunei and Sarawak; Professor of Dendrology, Harvard University, U.S.A.)

Gard. Bull. Sing. 50 (1998) 201. **Type:** *Dayang Awa & Lee S. 47846*, Borneo, Sarawak, Limbang (holotype KEP; isotypes CGE, K, L, SAN, SAR).

Monoecious tree, up to 30 m tall, 60 cm diameter. **Twigs** yellowish brown, irregularly ridged. **Stipules** ovate to lanceolate, acute, *c.* 2.5 cm long, caducous. **Leaves** *spirally arranged*, *coriaceous*, *glabrous*; *elliptic*, 14.5–17.5 × 6.5–9 cm, base broadly cuneate, *margin entire*, *plane*, *apex acute*; *midrib sunken above*; *lateral veins* 6–7 pairs, curving and joining near the leaf margin, raised below, *faintly raised above*, *basal pair reaching more than 1/3 the length of the blade*, departing at an acute angle from the midrib; intercostal venation scalariform, distinct below, invisible above; *petiole 2.2–3.7 cm long*, wrinkled on drying. **Syconia** *axillary*, ripening orange to deep red, *sessile*, oblong, *c.* 2 × 1 cm, apex flat with disc-like bracts; basal bracts large, united and cup-shaped, with rounded apex, persistent. **Tepals** 3, lanceolate, acuminate. **Achenes** ovoid, *c.* 2 mm long, with a few irregular protrusions.

Distribution. Endemic to Borneo. Rare, known only from Bario and Limbang districts in Sarawak.

Ecology. In hill mixed dipterocarp forest, up to 1000 m altitude.

4. **Ficus aurata** (Miq.) Miq.

(Latin, *auratus* = flecked with gold; the golden yellow hairs on the leaves)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 271; Corner *l.c.* (1965) 49, *l.c.* (1988) 546; Kochummen *l.c.* 140; Anderson *l.c.* 257; Primack *l.c.* 72; Whitmore, Tantra & Sutisna *l.c.* 240; Turner *l.c.* 348; Coode *et al.* (eds.) *l.c.* 212. **Basionym:** *Covellia aurata* Miq. *l.c.* (1861) 433. **Syntypes:** *Teijsmann HB 3426*, Sumatra, Bangka, Djebus (U); *Teijsmann HB 3713*, Sumatra, Palembang, Ogan Ulu (U); *Teijsmann HB 4517*, Sumatra, Lampong (U). **Synonyms:** *F. aurata* (Miq.) Miq. var. *densiserra* Miq. *l.c.* (1867) 271; *F. chrysocarpa* (*non* Reinw. *ex* Blume) King *l.c.* (1888) 151; *F. chrysocarpa* (*non* Reinw. *ex* Blume) King var. *undulata* Gibbs, J. Linn. Soc. Bot. 42 (1914) 137.

Dioecious tree, up to 10 m tall, 10 cm diameter. **Bark** whitish, smooth. *Young twigs*, *stipules*, *lower leaf surface, petioles*, *and syconia densely velvety with golden yellow hairs*, *or rarely rough-hairy* (var. *brevipilosa*). **Twigs** 0.2–0.5 cm thick, brownish, ridged, with distinct stipular scars. **Stipules** lanceolate, acute, up to 1.5 cm long. **Leaves** *spirally arranged*, thin-coriaceous, *sparsely rough hairy above*; elliptic, narrowly oblong or obovate, (5.5–)10.5–28 × (3–)4–15 cm, *base symmetric*, *cuneate*, *margin distinctly toothed from the base to apex*, *apex acute*; *midrib slightly raised above*; lateral veins 4–6 pairs, with shorter veins in between, faint above, raised below, *basal pair reaching almost 1/2 the length of the blade*, departing at an acute angle from the midrib, *with a faint gland in each axil below*; intercostal venation scalariform to reticulate, distinctly raised below, faint to invisible above; petiole 0.7–7 cm long, wrinkled on drying. **Syconia** *axillary or borne on twigs behind the leaves*, ripening yellow, *sessile*, globose, *up to 1(–2) cm diameter*, with umbonate apex, *surface strongly wrinkled on drying*, *velvety yellowish hairy*; basal bracts 3, ovate, acute, 2–3.5 mm long; internal bristles numerous. **Tepals** 3–4, glabrous or densely hairy, yellowish. **Achenes** ellipsoid, up to 1 mm long, keeled, tuberculate.

Vernacular names. Sarawak—*kumpan*, *tempan* (Iban).

Distribution. Indo-China, Sumatra, Peninsular Malaysia, and Borneo. Common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland to lower montane forests, up to 1300 m altitude; growing in a variety of soils and habitats, including secondary forest.

Key to varieties

1. Hairs on twigs, petioles and syconia sparse, up to 1 mm long.........………...…………………..
    var. **brevipilosa** Corner
    (Latin, *brevi* = short, *pilosus* = hairy with ascending hairs; the twigs petioles and syconia)

Gard. Bull. Sing. 17 (1960) 437, *l.c.* (1965) 49; Whitmore, Tantra & Sutisna *l.c.* 240. Type: *Bur. Sci. 602*, Borneo, Sabah (PNH?). Synonym: *F. inaequipetiolata* Merr., Philip. J. Sc. 21 (1922) 517.

Common in Sabah, not yet recorded for Sarawak.

Hairs on twigs, petioles and syconia 1–4 mm long.......………...……………………...……2

2. Leaves drying dark brown.......………………………………...……….……….………..

var. **palawanensis** Corner

(of Palawan)

Gard. Bull. Sing. 17 (1960) 437, *l.c.* (1965) 49; Whitmore, Tantra & Sutisna *l.c.* 240; Turner *l.c.* 348. Type: *Bur. Sci. 77382*, the Philippines, Palawan (holotype SING).

In Borneo very rare, known by a single collection from Sabah.

Leaves drying golden yellow.......…………………………….……………...…...….……3

3. Hairs 2–4 mm long. Leaves narrowly oblong.......……………………………....…………

var. **longipilosa** Corner

(Latin, *longus* = long, *pilosus* = hairy with ascending hairs; the twigs, petioles and syconia)

Gard. Bull. Sing. 17 (1960) 437, *l.c.* (1965) 49; Kochummen *l.c.* 141; Whitmore, Tantra & Sutisna *l.c.* 241; Turner *l.c.* 348; Coode *et al.* (eds.) *l.c.* 212. Type: *SFN 32313*, Peninsular Malaysia, Perak (holotype SING).

Sumatra, Peninsular Malaysia, and Borneo. Very rare in Sarawak, known by a single collection, *S. 3924*, from Belaga district.

Hairs 1–2 mm long. Leaves obovate or elliptic.......…………………......……...var. **aurata**

5. **Ficus aurita** Reinw. *ex* Blume

(Latin, *auritus* = with ear-like lobes; the leaf base)

Bijdr. Fl. Ned. Ind. (1825) 462; Corner *l.c.* (1965) 77; Whitmore, Tantra & Sutisna *l.c.* 241. **Type:** *Reinwardt 1451* (= *RHL Sheet No. 9081861497*), Maluku, Nusa Laut (holotype L). **Synonym:** *F. hispidulosa* Elmer, Leafl. Philip. Bot. 7 (1914) 2401.

Dioecious shrub or small tree, up to 7 m tall. **Twigs** up to 0.2 cm thick, *angled*, *soft-hairy*. **Stipules** paired, lanceolate, up to 2 cm long, hairy, persistent or caducous. **Leaves** *distichous*, thin-coriaceous, *soft-hairy below*; elliptic to lanceolate, 7.5–23.5 × 2.3–11 cm, *base asymmetric*, *cuneate*, *distinctly auriculate or not*, *margin slightly toothed or incised*, *apex acuminate*, *acumen* 2–*3 cm long*; *midrib raised above*, *with a gland at the base below*; lateral veins 4–8 pairs, raised below, faint above, basal pairs short, departing at a broad angle from the midrib; intercostal venation reticulate, visible below, invisible above; petiole up to 1 cm long, hairy. **Syconia** *axillary*, *solitary*, fulvous hairy, ripening orange to red, globose or ellipsoid, *up to 0.6 cm diameter*, apex umbonate; lateral bracts 1–2; internal bristles absent. **Tepals** 3–4, white, glabrous, entire or with toothed margin, free. **Achenes** up to 1 mm long, slightly compressed, distinctly keeled at the apex.

Vernacular name. Sarawak—*punoh* (Kelabit).

Distribution. Borneo, the Philippines, Sulawesi, Maluku, and New Guinea. Very rare in Sabah and Sarawak. Also in Kalimantan.

Ecology. In lowland, including limestone habitat, to lower montane forests, up to 1600 m altitude.

Key to varieties

Leaf base distinctly auriculate; stipules persistent........…………….....…...……..…var. **aurita**
Leaf base not auriculate; stipules caducous........……………………....……………………...
var. **auriculifera** (Merr.) Corner
(Latin, *auriculiferus* = bearing small ear; the leaf base)

Gard. Bull. Sing. 17 (1960) 480, *l.c.* (1965) 78; Anderson *l.c.* 257; Whitmore, Tantra & Sutisna *l.c.* 241. Basionym: *F. auriculifera* Merr., PEB (1929) 46. Type: *Elmer 20468*, Borneo, Sabah, Tawau district (holotype SING).

Very rare in Sabah and Sarawak. Also in Kalimantan.

6. **Ficus beccarii** King
(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Ann. Roy. Bot. Gard. Calc. 1, 2 (1888) 102; Merrill *l.c.* (1921) 221; Masamune *l.c.* 243; Corner *l.c.* (1965) 92; Kochummen *l.c.* 141; Anderson *l.c.* 257; Primack *l.c.* 73; Whitmore, Tantra & Sutisna *l.c.* 241. **Type:** *Beccari PB 2900*, Borneo, Sarawak (holotype FI).

Dioecious treelet, up to 5 m tall. **Twigs** *c.* 0.2 cm thick, fulvous appressed hairy. **Stipules** linear to lanceolate, hairy, *c.* 3.5 cm long, *persistent.* **Leaves** *distichous*, thin-coriaceous, *fulvous appressed hairy below*; oblong, elliptic, lanceolate, or obovate, 25–38 × 3–11 cm, base cuneate, symmetric or asymmetric, *margin entire and plane* or faintly toothed near the apex, apex shortly acuminate; *midrib sunken above*; lateral veins 9–12 pairs, raised below, faint above, basal veins 1–2 pairs, short, departing at a broad angle from the midrib; intercostal venation scalariform, distinct below, faint to invisible above; petiole appressed yellowish hairy, 1–1.5 cm long. **Syconia** *solitary, sessile, borne on much divided, leafless, stipule-bearing branches arising from the base of stem*, depressed globose, 0.7–1.7 cm diameter, *with many bracts on the surface*; basal bracts 3. **Achenes** up to 0.7 mm long, shallowly ridged.

Vernacular names. Sarawak—*buah abung* (Kelabit), *entimau* (Iban).

Distribution. Peninsular Malaysia and Borneo. Rare in Sabah and Sarawak. Var. *beccarii* also occurs in Kalimantan.

Ecology. In lowland mixed dipterocarp to lower montane forests, up to 1800 m altitude.

Key to varieties

1. Leaves 3–6 cm broad........………………………….………...…………………var. **beccarii**
Leaves 5–11 cm broad........……………………………....…….….……………………2

2. Leaf base asymmetric........………………………………...……….………………………
var. **asymmetrica** Corner
(Latin, *asymmetricus* = asymmetric; the leaf base)

Gard. Bull. Sing. 18 (1960) 60, *l.c.* (1965) 92; Whitmore, Tantra & Sutisna *l.c.* 241. Type: *Corner s.n.*, Borneo, Sarawak, Kuching district, Bt. Kuap (holotype CGE; isotype L).

Leaves oblong, elliptic or obovate, 26–28 × 7.5–11 cm; *base asymmetric with one side narrowly cuneate and the other broadly subcordate*, margin entire, apex acuminate, acumen 2.5–4.5 cm long.

Endemic to Borneo. Very rare, only known by the type collection from Sarawak. In lowland mixed dipterocarp forest.

Leaf base symmetric..……..………………………………...………………………………

var. **latifolia** Corner

(Latin, *latifolius* = broad-leaved)

Gard. Bull. Sing. 18 (1960) 60, *l.c.* (1965) 92; Whitmore, Tantra & Sutisna *l.c.* 241; Coode *et al.* (eds.) *l.c.* 212. Type: *BRUN 5305*, Brunei, Sg. Belalong (holotype CGE).

Leaves elliptic or lanceolate, 5–10 cm broad; *base symmetric*, broadly cuneate, margin entire and plane or slightly toothed towards apex, apex acute.

Endemic to Borneo. Rare in Sabah, in lowland to lower montane forests, up to 1800 m altitude. Also in Brunei. Not known in Sarawak and Kalimantan.

7. **Ficus benjamina** L.

(Sanskrit, *bani*; the banyan tree)

Mant. 1 (1767) 129; Blume *l.c.* 456; Miquel *l.c.* (1867) 267; King *l.c.* (1887) 43; Merrill *l.c.* (1921) 221; Ridley *l.c.* (1924) 336; Burkill *l.c.* 1021; Masamune *l.c.* 243; Backer & Bakhuizen *f. l.c.* 24; Corner *l.c.* (1965) 21, *l.c.* (1988) 539; Kochummen *l.c.* 141; Anderson *l.c.* 257; Primack *l.c.* 74; Whitmore, Tantra & Sutisna *l.c.* 241; Argent *et al.* (eds.) *l.c.* 439. **Type:** *Linn. Herb.* (BM?). **Synonyms:** *F. nitida* Thunb., Diss. Fic. (1785) 5; *F. haematocarpa* Blume *ex* Decne., Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 494; *F. neglecta* Blume *ex* Decne *l.c.* 494; *Urostigma benjaminum* (L.) Miq. *in* Hooker, Lond. J. Bot. 6 (1847) 583; *U. haematocarpum* (Blume *ex* Decne.) Miq. *l.c.* (1847) 584; *U. nitidum* (Thunb.) Miq. *l.c.* (1847) 582; *U. neglectum* (Blume *ex* Decne.) Miq., Fl. Ned. Ind. 1, 2 (1859) 347.

Monoecious tree or strangler, up to 30 m tall, 40 cm diameter, with few free hanging aerial roots and *drooping branches*. **Bark** light grey. *All parts glabrous*. **Twigs** up to 0.2 cm thick, dark brown, reddish brown when young, angled. **Stipules** paired, broadly lanceolate, acute, *c.* 1 cm long, caducous. **Leaves** *distichous*, thin-coriaceous, *withering yellow*; elliptic to ovate-lanceolate, *4–8 × 1.8–3.8 cm*, base cuneate, *margin entire*, *plane*, apex acute; *midrib raised above*, drying yellowish on both surfaces; *lateral veins numerous*, *closely spaced*, *almost parallel*, visible on both surfaces, *joining near the leaf margin to form distinct intramarginal vein*, basal pair short; intercostal venation reticulate, equally prominent as lateral veins; petiole 0.5–1.5 cm long, *wrinkled and yellowish on drying*. **Syconia** *axillary*, *paired*, *sessile*, ripening orange-yellow, *globose*, *c.* 0.8 cm diameter, apex flat, drying pale yellowish with rugose surface; *basal bracts* 2–3, *0.5–1.5 mm long*, *concealed beneath the syconia*; ostiole covered by 3 small apical bracts; internal bristles none. **Tepals** 3–4, free. **Achenes** ovoid to reniform, *longer than the style*.

Vernacular names. Sarawak—*beringin*, *waringin* (Malay), *dunuk* (Bidayuh).

Distribution. India, S China, Malesia, Solomon Islands, and N Australia. Common in Sabah and Sarawak. Also in Kalimantan.

Ecology. In lowland and hill forests, up to 600 m altitude, usually by streams; often planted in urban areas.

8. **Ficus bruneiensis** Corner Fig. 6.

(of Brunei)

Gard. Bull. Sing. 17 (1960) 435, *l.c.* (1965) 48; Anderson *l.c.* 257; Primack *l.c.* 75; Whitmore, Tantra & Sutisna *l.c.* 242; Coode *et al.* (eds.) *l.c.* 212. **Type:** *Corner BRUN 5383*, Borneo, Brunei, Amo, Ulu Belalong (holotype CGE; isotype L).

Dioecious tree, up to 20 m tall, 45 cm diameter. **Twigs** *glabrous*, *hollow*, 0.8–1.5 cm thick, reddish brown, shallowly ridged, with prominent stipular scars. **Stipules** lanceolate, acute, 3.5–5.2 cm long, minutely appressed silky hairy, caducous. **Leaves** *spirally arranged*, coriaceous, *rough-hairy above*, *yellowish brown soft-hairy below*; elliptic, ovate or oblong, 20–37 × 11–24 cm, *base rounded or subcordate* (distinctly cordate in young trees), *margin toothed*, apex acute; *midrib raised above*; lateral veins 5 pairs, prominently raised below, faint above, basal pair reaching more than 1/2 the length of the blade, *with a gland in each axil below*; intercostal venation reticulate to scalariform, prominent below, faint above; petiole 5.5–11 cm long, sparsely long-hairy. **Syconia** *axillary*, *paired*, *sessile*, ripening red, oblong or ellipsoid, *2–3.5 × 2.5–3 cm*, *covered with rough long yellow hairs*; basal bracts 3, ovate, 6–10 mm long, caducous; internal bristles numerous, yellowish. **Tepals** 3–4, yellowish to reddish, almost linear, densely long-hairy. **Achenes** oblong, smooth, ridged on the side where style comes out.

Vernacular names. Sarawak—*kempan*, *kumpan*, *tempan* (Iban).

Distribution. Endemic to Borneo. Common in Sarawak and known from Belaga, Kapit, and Lubok Antu districts; not yet reported for Sabah. Also in Brunei.

Ecology. In lowland and hill mixed dipterocarp forests, up to 500 m altitude, usually by streams.

9. **Ficus brunneoaurata** Corner

(Latin, *brunneus* = brown, *auratus* = flecked with gold; the yellowish brown indumentum)

Gard. Bull. Sing. 17 (1960) 436, *l.c.* (1965) 48; Anderson *l.c.* 257; Primack *l.c.* 76; Whitmore, Tantra & Sutisna *l.c.* 242; Coode *et al.* (eds.) *l.c.* 212. **Type:** *SFN 26608*, Borneo, Sabah, Mt. Kinabalu, Menetendok Gorge (holotype SING).

Dioecious tree, up to 15 m tall, 20 cm diameter. *Twigs*, *petioles and leaf undersurface yellowish brown hairy*. **Twigs** 0.3–1 cm thick, dark brown, striate, with distinct stipular scars. **Stipules** lanceolate, acute, 1–3.5 cm long, velvety hairy. **Leaves** *spirally arranged*, coriaceous; ovate-elliptic, 15–30 × 6–14 cm (lobed and up to 50 × 14 cm in juvenile trees), *base subcordate* to cuneate, *margin faintly toothed*, apex acute; *midrib raised above*; lateral veins 4–5 pairs, raised on both surfaces, *with glands in the axils of lateral veins below*, basal veins 2–3 pairs, reaching more than 1/2 the length of the blade; intercostal venation scalariform, visible on both surfaces; petiole 1.5–8 cm long. **Syconia** *axillary or borne on twigs behind the leaves*, *sessile*, ripening red, *short velvety yellowish brown hairy*, subglobose, *1–1.8 cm diameter*; *basal bracts 1–1.5 mm long*; internal bristles numerous, brownish. **Tepals** 3–4, reddish, densely hairy. **Achenes** keeled and tuberculate.

Vernacular names. Sabah—*tegong* (Dusun). Sarawak—*kupan*, *tempan* (Iban).

Distribution. Endemic to Borneo. Common in Sabah especially on Mt. Kinabalu, frequent in Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, up to 1100 m altitude, including secondary forest.

10. **Ficus callosa** Willd. Fig. 7.

(Latin, *callosus* = bearing hardened thickenings; probably referring to the syconia-bearing branches and stem or to the densely sclerotic syconium wall)

Act. Acad. Berol. (1798) 102; Miquel *l.c.* (1867) 295; King *l.c.* (1887) 64; Merrill *l.c.* (1921) 221; Masamune *l.c.* 243; Backer & Bakhuizen *f. l.c.* 32; Corner *l.c.* (1965) 29, *l.c.* (1988) 546; Kochummen *l.c.* 142; Anderson *l.c.* 257; Primack *l.c.* 77; Whitmore, Tantra & Sutisna *l.c.* 242; Turner *l.c.* 349. **Type:** unknown. **Synonyms:** *F. scleroptera* Miq., Pl. Jungh. (1851) 63; *F. basidentula* Miq. *l.c.* (1859) 314; *F. malunuensis* Warb. *in* Perkin, Fragm. Fl. Philip. 3 (1905) 196; *F. cordatifolia* Elmer, Leaft. Philip. Bot. 4 (1911) 1250; *F. longispathulata* Sata, Monogr. (1944) 323.

Monoecious tree, up to 33 m tall, 90 cm diameter, *without free hanging aerial roots*; buttresses up to 3 m tall. **Bark** pale grey to dark brown, smooth; inner bark pale orange-brown; sap watery, white. **Sapwood** orange to cream. **Twigs** 0.3–0.8 cm thick, yellowish with dark brown lenticels. **Stipules** 1.2–3 cm long, caducous. **Leaves** *spirally arranged*, coriaceous, *glabrous*; *elliptic or oblong*, *14–27 × 5.5–14 cm*, *base symmetric*, *rounded or broadly cuneate*, *margin entire*, *plane*, *apex rounded or obtuse*; *midrib raised above*; *lateral veins 7–10 pairs*, *well-spaced*, *curved*, *departing from the midrib at a broad angle*, distinct on both surfaces, basal veins 2–3 pairs, *distinct*, reaching up to 1/3 the length of the blade, *without glands in the axils below*; *intercostal venation reticulate*, visible on both surfaces; *petiole 3.5–7 cm long*, drying yellowish. **Syconia** *axillary or borne on the twigs behind the leaves*, ripening yellow, finely villous, glabrescent, pear-shaped, 1.5–2.5 × 1.2–2 cm, apex with tiny ostiole; *peduncle* slender, *2–3 cm long*; basal bracts 3, 1.5–4 mm long, persistent; internal bristles none. **Tepals** 3–6, red, free, glabrous. **Achenes** oblong, *c.* 1.5 mm long, slightly keeled.

Vernacular name. Sabah—*kayu ara* (Malay).

Distribution. India, Sri Lanka, Andaman Islands, Burma, Indo-China, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Maluku, and Lesser Sunda Islands. Widely distributed in Sabah and Sarawak but nowhere abundant; often seen in urban areas. Also in Kalimantan.

Ecology. In lowland forest, especially in coastal areas.

11. **Ficus cereicarpa** Corner

(Greek, *ceras* = with horn-like projection, *karpos* = fruit; the lateral bracts on the syconia)

Gard. Bull. Sing. 18 (1960) 57, *l.c.* (1965) 91; Anderson *l.c.* 257; Primack *l.c.* 78; Whitmore, Tantra &

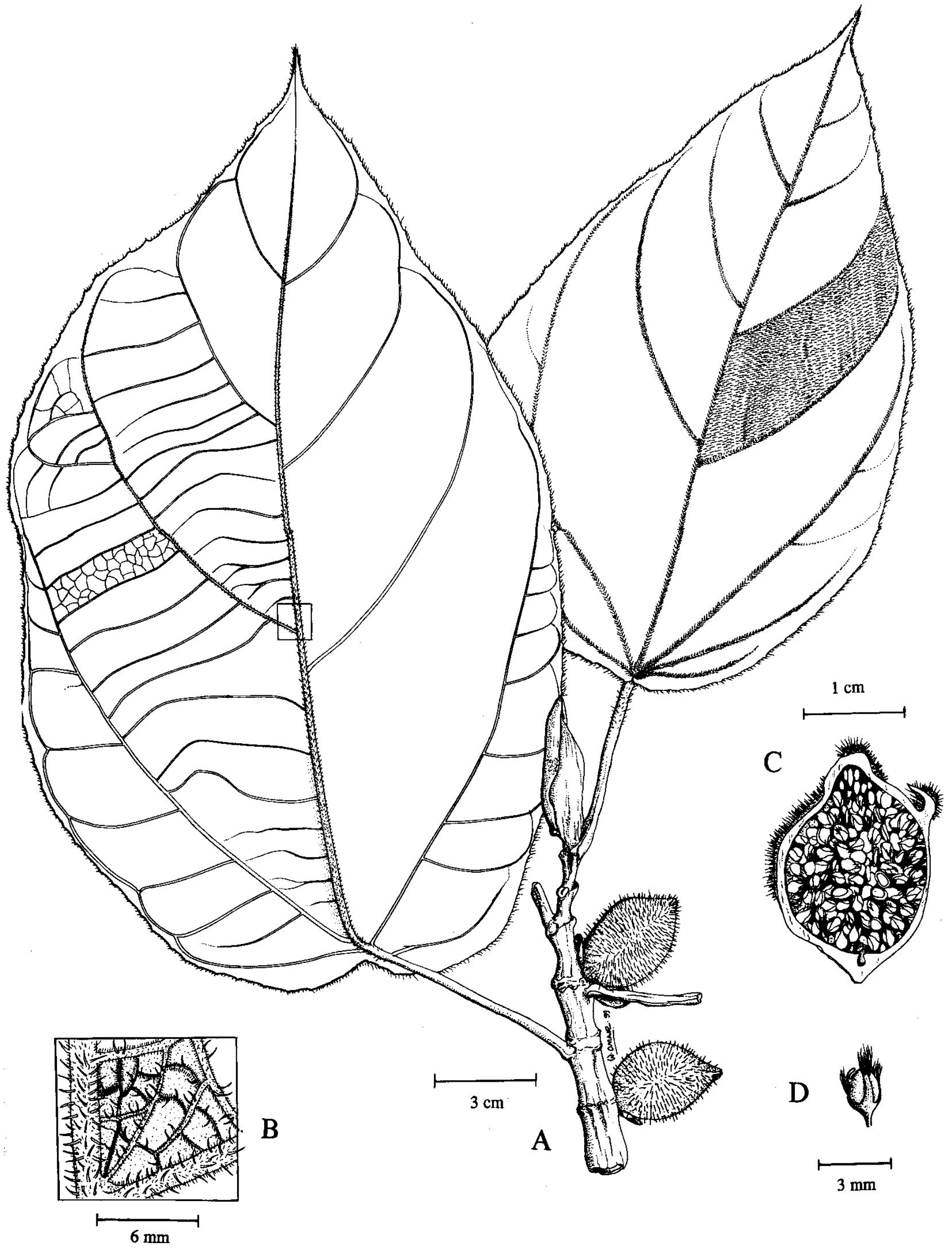

Fig. 6. *Ficus bruneiensis*. A, leafy twig with syconia; B, detail of lower leaf surface; C, longitudinal section of mature syconium containing fruits; D, developing fruit substended by 3 tepals. (From *Chai S. 34065.*)

Sutisna *l.c.* 243; Coode *et al.* (eds.) *l.c.* 212. **Type:** *Corner BRUN 5315*, Borneo, Brunei, Amo, Sg. Belalong (holotype CGE; isotype SAR).

Dioecious tree, up to 9 m tall. **Twigs** 0.4–1.8 cm thick, reddish brown, shallowly ridged, with prominent stipular scars; young parts covered with white, silky, appressed or spreading hairs. **Stipules** lanceolate, 1.7–5 cm long, appressed velvety hairy, subpersistent. **Leaves** *spirally arranged*, thin-coriaceous, *sparsely yellowish brown hairy below*, especially on midrib and lateral veins; elliptic, ovate or obovate, 13–43 × 6.5–26 cm, *base subcordate or cordate*, *margin entire*, *plane*, apex acute; *midrib raised above*; lateral veins 8–20 pairs, distinct on both surfaces, basal veins 2–4 pairs, *short*, *departing at a broad angle from the midrib*, *without glands in the axils below*; intercostal venation scalariform to reticulate, distinctly visible below; petiole 2–13.5 cm long, glabrous or hairy, wrinkled on drying. **Syconia** *borne in dense clusters on stout leafless branching twigs up to 30 cm long arising from the base of trunk*, ripening brown to pink, finely hairy, *pear-shaped*, *2.5–3 cm long*; *peduncle 2–3 cm long*; basal bracts 3, *lateral bracts horn-like*, *thick and many*, apical bracts lanceolate, thick, many; internal bristles numerous, flexuous. **Tepals** fused into a cup-shaped or tubular perianth, reddish. **Achenes** *c.* 1 mm long, rough to smooth, slightly keeled.

Vernacular name. Sarawak—*sampandai* (Iban).

Distribution. Endemic to Borneo. Frequent in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp to lower montane forests, up to 1600 m altitude, usually by streams.

Key to varieties

Twig slender, 0.4–0.9 cm thick. Leaf base subcordate; hairs sparse, up to 4 mm long. Syconia with peduncle up to 1 cm long……………………….................…....….var. **cereicarpa**

Twig stout, up to 1.8 cm thick. Leaf base distinctly cordate; hairs dense, longer than 4 mm. Syconia with peduncle up to 3 cm long…………………………………………………

var. **ashtonii** Kochummen

Gard. Bull. Sing. 50 (1998) 213. Type: *Ashton S. 17806*, Borneo, Sarawak, Kapit district, Batang Baleh, Ulu Selentang (holotype KEP; isotypes A, BO, CGE, K, L, SAR, SING).

Differs from the typical variety in the stouter twigs, very large cordate leaves which are at least 20 cm broad, and in the long peduncled syconia.

Endemic to Borneo; recorded only for Sarawak by 3 collections, *S. 45512* from Belaga district, *S. 40302* from Miri district (Lambir Hill NP), and the type from Batang Baleh in Kapit district.

12. **Ficus chaii** Kochummen

(Paul P.K. Chai 1941–, sometime Forest Botanist at the Herbarium, Forestry Department of Sarawak)

Gard. Bull. Sing. 50 (1998) 203. **Type:** *Chai S. 36002*, Borneo, Sarawak, Kapit district, Sg. Kapit (holotype KEP; isotypes SAN, SAR).

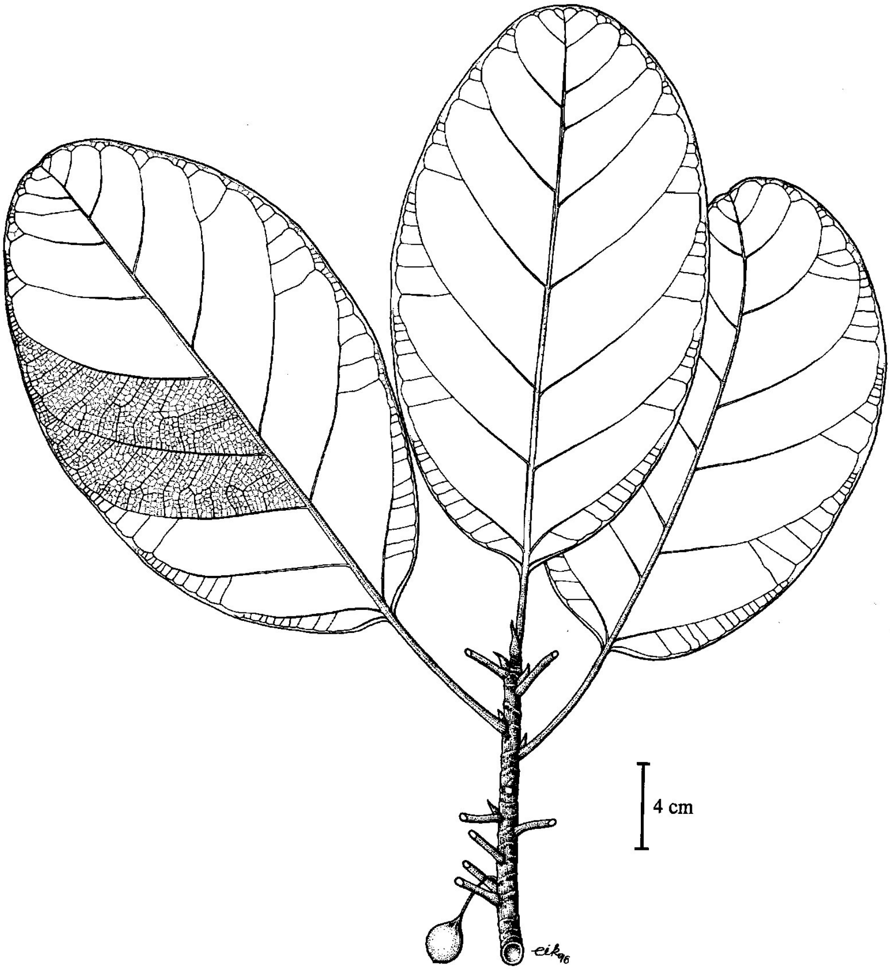

Fig. 7. *Ficus callosa*. Leafy twig with a syconium. (From *Lee S. 41835*.)

Treelet. **Twigs** reddish brown, angled. **Stipules** lanceolate, up to 1 cm long, finely hairy outside, caducous. **Leaves** *spirally arranged*, thin-coriaceous, *glabrous*, drying greenish yellow; *narrowly oblong*, *13.5–23.5 × 1.5–2.2 cm*, *base cuneate*, *margin distantly toothed*, apex acuminate, acumen 1–2 cm long; *midrib raised above*; *lateral veins 13–21 pairs*, distinctly curving and joining near the leaf margin, visible below, very faint above, basal pairs short; intercostal venation reticulate, visible below; petiole 1–1.5 cm long, yellowish on drying. **Syconia** *axillary*, *solitary or in pairs*, ripening orange, pear-shaped, 0.5–0.8 × 0.3–0.4 cm; *peduncle to 0.3 cm long*; basal bracts tiny. **Tepals** 3, lanceolate, transparent. **Achenes** not seen.

Distribution. Endemic to Borneo. Known only by the type specimens from Sarawak.

Ecology. In lowland mixed dipterocarp forest by stream.

13. **Ficus chartacea** (Wall. *ex* Kurz) King

(Latin, *chartaceus* = papery; the leaves)

Ann. Roy. Bot. Gard. Calc. 1, 2 (1888) 159; Ridley *l.c.* (1924) 350; Burkill *l.c.* 1022; Corner *l.c.* (1965) 47, *l.c.* (1988) 547; Kochummen *l.c.* 142; Anderson *l.c.* 257; Primack *l.c.* 78; Whitmore, Tantra & Sutisna *l.c.* 243; Turner *l.c.* 349; Coode *et al.* (eds.) *l.c.* 213. **Type:** *Wall. Cat. 4580*, Peninsular Malaysia, Penang (K?). **Synonym:** *F. lamponga* Miq. var. *chartacea* Wall. *ex* Kurz, Fl. Burma 2 (1877) 451.

Dioecious shrub or small tree, up to 12 m tall, *without free hanging aerial roots*. **Bark** greyish white to dull brown. Young twigs and petioles pink. **Twigs** up to 0.2 cm thick. **Stipules** lanceolate, 0.3–1 cm long, glabrous, caducous. **Leaves** *spirally arranged*, thin-coriaceous, *glabrous*, *with cream white or yellow dots on the upper surface*; *elliptic*, *7.5–15 × 2.5–6 cm*, *base symmetric*, *cuneate*, *margin entire*, *plane*, *apex acute*; *midrib raised above*; *lateral veins 4–6 pairs*, *well-spaced*, *curved*, *departing from the midrib at a broad angle*, distinct on both surfaces, *basal pair distinct*, *extending up to 1/2 the length of the blade*, *with a gland in each axil below*; *intercostal venation reticulate*, visible on both surfaces; *petiole 1–3 cm long*, slender. **Syconia** *sessile or with short peduncle*, *in pairs or clustered*, *axillary or borne on twigs behind the leaves*, ripening yellow or orange-brown and then scarlet, globose, 0.6–0.8 cm diameter, apex umbonate; basal bracts 3, tiny; internal bristles few, small. **Tepals** 3–4, free. **Achenes** ovoid, *c.* 1 mm long, tuberculate, rather strongly keeled.

Distribution. Burma, Indo-China, Thailand, Peninsular Malaysia, and Borneo. Common in Sabah, not yet reported for Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland forest, often by streams.

14. **Ficus cumingii** Miq.

(H. Cuming, 1791–1865, English traveller and naturalist; collected a large number of plant specimens in S America, the Pacific Islands, the Philippines, Singapore, Peninsular Malaysia and Sumatra)

In Hooker, Lond. J. Bot. 7 (1848) 235; King *l.c.* (1888) 92; Corner *l.c.* (1965) 66. **Type:** *Cuming 1925*, the Philippines (K).

Dioecious shrub, up to 4 cm tall; latex white. *Young shoots*, *petioles*, *peduncles and undersurface of leaves rough-hairy.* **Twigs** up to 0.2 cm thick, pale brown. **Stipules** paired, up to 1 cm long, caducous. **Leaves** *subopposite*, *scabrous*; narrowly lanceolate, 6–30 × 1.2–5 cm, *base cuneate to rounded*, *margin distantly faintly lobed or toothed*, *apex obtuse*; *midrib raised above*; lateral veins 14–25 pairs, faintly raised below, basal pair short, departing at a broad angle from the midrib, *with 1–2 glands in the axils below*; intercostal venation reticulate; petiole *c.* 0.8 cm long. **Syconia** *axillary*, ripening yellow to red, globose, *c. 0.6 cm diameter*, scabrous; *peduncle 0.1–0.4 cm long*; basal bracts 3; internal bristles numerous, short. **Tepals** 3–5, free. **Achenes** lenticular, up to 1.2 mm long, smooth, slightly keeled.

Distribution. Formosa, Borneo, the Philippines, Sulawesi, and New Guinea. One variety is present in Sabah.

Ecology. In lowland forest, including rocky coastal forest.

var. **terminalifolia** (Elmer) Sata
(having leaves resembling those of *Terminalia*, Combretaceae)

Monogr. (1944) 239; Corner *l.c.* (1965) 66; Whitmore, Tantra & Sutisna *l.c.* 243. **Basionym:** *F. terminalifolia* Elmer, Leafl. Philip. Bot. 4 (1911) 318. **Type:** unknown. **Synonym:** *F. producta* Merr., En. Philip. Pl. 2 (1923) 62.

Young twigs and leaves covered with rough hairs; leaf margin faintly lobed or toothed. Syconia axillary, globose, sessile, rough-hairy.
Formosa, Borneo, and the Philippines. Very rare in Borneo, known by 3 collections, *SAN 103482*, *SAN 11158* and *Kamis 4157* from Tawau district in Sabah.

15. **Ficus deltoidea** Jack Fig. 8.

(Latin, *deltoideus* = deltoid, equilateral-triangular; the leaf shape)

Mal. Misc. 2 (1822) 71; Corner *l.c.* (1965) 37, Phil. Trans. Roy. Soc., London Ser. B, 256 (1969) 281, *l.c.* (1988) 554; Backer & Bakhuizen *f. l.c.* 28; Kochummen *l.c.* 145; Primack *l.c.* 81; Whitmore, Tantra & Sutisna *l.c.* 244; Turner *l.c.* 349; Coode *et al.* (eds.) *l.c.* 213. **Type:** *Jack s.n.*, Sumatra (BM). **Synonyms:** *F. diversifolia* Blume *l.c.* 456; *F. diversifolia* Blume var. *latissima* Miq. *l.c.* (1867) 268; *F. diversifolia* Blume var. *deltoidea* (Jack) Ridl. *l.c.* (1924) 346.

Dioecious shrub, *small tree or epiphyte*, up to 3 m tall. **Twigs** up to 0.2 cm thick. **Stipules** lanceolate, 0.15–1.5 cm long, caducous. **Leaves** *spirally arranged*, thin- to thick-coriaceous, *glabrous*; *deltoid*, elliptic, obovate, or spathulate or rhomboid, 2–16.5 × 1.5–10 cm, base tapered or cuneate, *margin entire or lobed*, *revolute or plane*, *apex rounded*, *notched*, *obtuse or acute*; *midrib usually forked near the middle and with a gland in the fork or not forked but with a gland in the axils of basal lateral veins below*, *raised*, *flat or sunken above*; lateral veins up to 10 pairs, curving and joining near the leaf margin, distinct or sometimes indistinct below, faint above; intercostal venation reticulate, equally prominent as the lateral veins or not prominent or indistinct on both surfaces; petiole 0.2–3 cm long. **Syconia** *in pairs or solitary*, *axillary*, ripening yellow or red, oblong, globose or ellipsoid, 0.3–2 × 0.2–1.2 cm, strongly umbonate at apex, glabrous or hairy; *peduncle 0.3–1.5 cm long or syconia almost sessile*; basal bracts 3, *c.* 1 mm long, persistent; internal bristles few, short. **Tepals** 3–4, red, glabrous, ovate to lanceolate, free. **Achenes** oblong to kidney-shaped, 3–5 × 2 mm, with few faint lines or smooth.

Vernacular names. Sarawak—*ara*, *kara* (Iban), *lunok* (Murut).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines. Common and widely distributed in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland, including peatswamp, *kerangas* and limestone to upper montane forests, up to 2600 m altitude.

Uses. A reputed traditional medicine. A decoction of leaves is taken after childbirth as a tonic drink.

Notes. A variable species with 15 recognised varieties (*cf.* Corner *l.c.* 1969). Eight of the varieties occur in Sabah and Sarawak.

Key to varieties

(The epiphytic varieties are annotated under the main key: leads 166 and 168)

1. Leaf penninerved, apex acute; midrib not forked........…………………….………….....2
   Leaf usually with one or 2 pairs of veins, rarely more, apex rounded; midrib forked…..3

2. Petiole up to 0.2 cm long. Midrib flat above. Common small trees of *kerangas* forest….
   var. **arenaria** Corner (in part)
   (Latin, *arenarius* = growing on sandy habitat)
   Gard. Bull. Sing. 17 (1960) 421, *l.c.* (1965) 37, *l.c.* (1969) 302; Whitmore, Tantra & Sutisna *l.c.* 244; Coode *et al.* (eds.) *l.c.* 213. Type: *BRUN 5352*, Borneo, Brunei, Kuala Belait (holotype CGE).
   Shrub up to 2 m tall. Leaves elliptic to narrowly obovate, 2.5–11 × 1.8–4 cm, base cuneate, margin lobed, apex acute or rounded; midrib not forked or rarely forked in some leaves towards the apex of the twig; lateral veins 3–5 pairs; petiole up to 0.2 cm long. Syconia ellipsoid, 1–1.2 × 0.7–0.9 cm; peduncle 0.1–0.9 cm long.
   Endemic to Borneo. Common in Sabah and Sarawak. Lowland *kerangas* forest. Also in Brunei and Kalimantan.
   Petiole very much longer than 0.2 cm. Midrib sunken above. Small trees of other habitats……………………………………………………....…………………………
   var. **intermedia** Corner
   (Latin, *intermedius* = intermediate between var. *lutescens* and var. *motleyana*)
   Gard. Bull. Sing. 17 (1960) 423, *l.c.* (1965) 37, *l.c.* (1969) 304; Kochummen *l.c.* 145; Whitmore, Tantra & Sutisna *l.c.* 244. Type: *Purseglove 4281*, Peninsular Malaysia, Pahang, Fraser's Hills (holotype SING). Synonyms: *F. kinabaluensis* Stapf, FMK (1894) 226; *F. burkillii* Ridl. *l.c.* (1924) 330.
   Shrub up to 3 m tall. Leaves elliptic to spathulate, 3–10 × 1.5–5.5 cm, base cuneate,

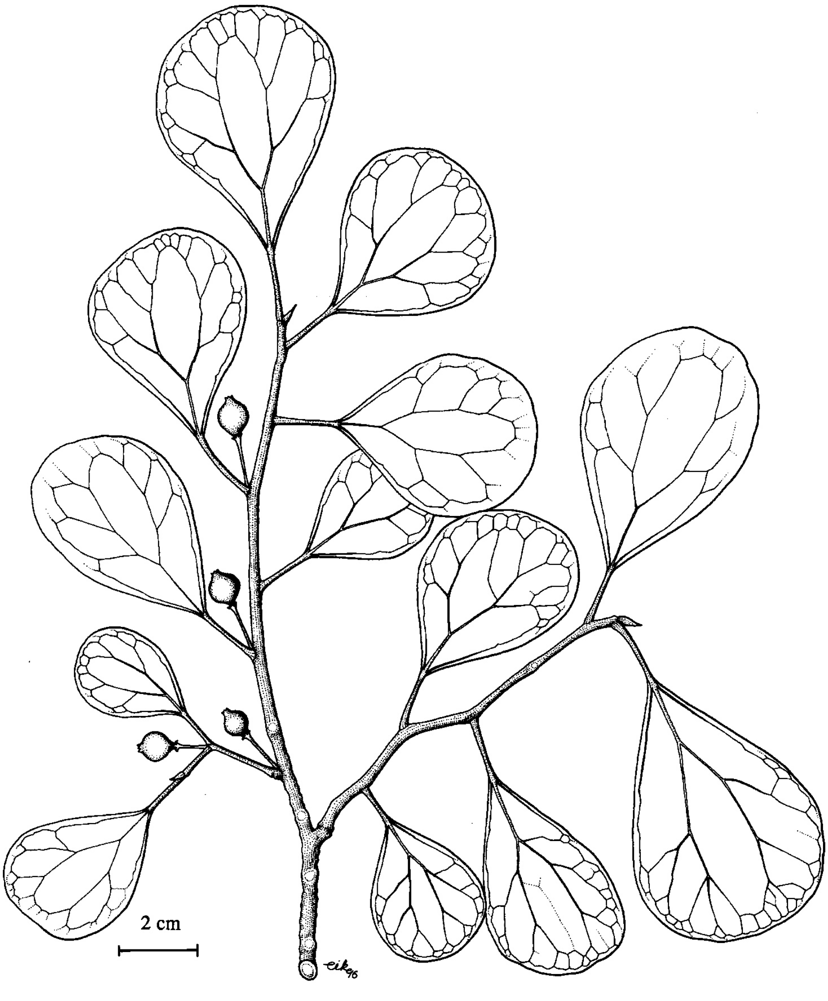

Fig. 8. *Ficus deltoidea* var. *deltoidea*. Leafy twig with syconia. (From *Martin & Pius SAN 117014.*)

margin entire, plane, apex obtuse or rounded; *midrib not forked*, except where leaves have rounded apex, *sunken above*; lateral veins 4–5 pairs, visible above, with a gland in each axil of the basal pair; *petiole 0.2–1.5 cm long*. Syconia subglobose; peduncle up to 1 cm long.

Peninsular Malaysia and Borneo. Common on Mt. Kinabalu in Sabah, not yet reported for Sarawak. In lowland to hill forests, up to 1000 m altitude.

3. Leaves deltoid, equally broad and long; midrib forking below the middle of the blade………………………………………………………...…………var. **deltoidea**
Leaves narrowly obovate, longer than broad; midrib usually forked above the middle of the blade.......…………………………………………......………………………4

4. Petiole up to 0.2 cm long.......……………………………………var. **arenaria** (in part)
Petiole at least 0.5 cm long.........…………………………………………………….5

5. Leaves up to 3.5 cm broad. Syconia glabrous................………………………………...
var. **angustifolia** (Miq.) Corner
(Latin, *angustifolius* = narrow-leaved)

Gard. Bull. Sing. 17 (1960) 420, *l.c.* (1965) 37, *l.c.* (1969) 300; Kochummen *l.c.* 145; Whitmore, Tantra & Sutisna *l.c.* 244; Coode *et al.* (eds.) *l.c.* 213. Basionym: *Synoecia diversifolia* (Blume) Miq. var. *angustifolia* Miq. *l.c.* (1851) 67. Type: unknown. Synonyms: *F. ovoidea* Jack *l.c.* 71; *F. spathulata* Miq. *l.c.* (1848) 441; *F. retusa* L. var. *ovoidea* (Jack) Miq. *l.c.* (1867) 288; *F. diversifolia* (Blume) Miq. var. *ovoidea* (Jack) King *l.c.* (1888) 140.

Lower Thailand, Sumatra, Peninsular Malaysia, and Borneo. Common in Sarawak, not yet reported for Sabah. Also in Brunei and Kalimantan. In hill to lower montane forests, at 800–1300 m altitude, including limestone habitat.

Leaves more than 4 cm broad. Syconia hairy......………………………………………
var. **borneensis** Corner
(of Borneo)

Gard. Bull. Sing. 17 (1959) 422, *l.c.* (1965) 37, *l.c.* (1969) 303; Whitmore, Tantra & Sutisna *l.c.* 244; Coode *et al.* (eds.) *l.c.* 214. Type: *Endert 3920*, Borneo, Kalimantan, W Kutai, Mt. Kemul (holotype L).

Twigs 0.2–0.5 cm thick. Leaves obovate or oblong, 4.5–13 × 3–9 cm, base cuneate to rounded, margin entire, revolute, *apex rounded*; midrib raised or sunken above, forked from near the middle of the blade; lateral vein one pair; petiole 0.5–2.5 cm long. Syconia glabrous or hairy, ovoid or oblong, 0.8–1.2 cm diameter; peduncle up to 0.6 cm long.

Endemic to Borneo. Frequent in Sarawak; very rare in Sabah, known by 2 collections, *SAN 25867* and *SAN 66909*, from Beaufort district. In lowland mixed dipterocarp to lower montane forests, up to 1500 m altitude.

16. **Ficus diamantiphylla** Corner

(Greek, *diamante* = decorated with sparkling spots, *phullon* = leaf)

Phil. Trans. Roy. Soc. London Ser. B, 259 (1970) 368; Anderson *l.c.* 258; Primack *l.c.* 83; Whitmore, Tantra & Sutisna *l.c.* 244. **Type:** *S. 22791*, Borneo, Sarawak, Marudi district, Ulu Tutoh (holotype SAR).

Dioecious tree up to 6 m high. **Twigs** *hollow*, finely ridged with raised lines, *c.* 1.2 cm thick, long-woolly hairy. **Leaves** *spirally arranged*, *rough-hairy on both surfaces*, *drying yellowish*; obovate, 20–41.5 × 13–20 cm, base subcordate, *margin finely toothed*, apex acute; *midrib sunken above*, densely hairy; lateral veins 7–8 pairs, prominently raised below, visible above; intercostal venation reticulate, raised below; *petiole 7–7.5 cm long*, *woolly hairy*. **Syconia** yellow, ripening red, densely tomentose.

Distribution. Endemic to Borneo. Very rare, known only by the type collection from Sarawak.

Ecology. In lowland mixed dipterocarp forest by stream.

17. **Ficus endospermifolia** Corner Fig. 9.

(having leaves like that of *Endospermum*, Euphorbiaceae)

Gard. Bull. Sing. 17 (1960) 434, *l.c.* (1965) 48; Whitmore, Tantra & Sutisna *l.c.* 245. **Type:** *SAN A 4492*, Borneo, Sabah, Mt. Kinabalu, Tenompok (holotype K).

Dioecious tree, up to 25 m tall. **Twigs** 0.4–0.7 cm thick, *brown hairy*, strongly grooved, with prominent petiolar and stipular scars. **Stipules** ovate, acute, 1–3 cm long, velvety yellowish hairy. **Leaves** *spirally arranged*, coriaceous, *densely velvety hairy on both surfaces*, denser below; broadly ovate, 13–25 cm long and almost equally broad, *base truncate to cordate*, *margin faintly toothed*, apex acute; *midrib raised above*; lateral veins 4–5 pairs, departing from near the base of midrib, strongly raised below, visible above, basal pair reaching almost 1/2 the length of the blade, *with a gland in each axil below*; intercostal venation scalariform, raised below, faint to invisible above; petiole 3.5–10 cm long, yellowish, hairy. **Syconia** *axillary*, *sessile*, velvety hairy, ovoid to subglobose, *1.8–2.5 × 1.5–2 cm*; basal bracts ovate, 3–5 mm long, caducous; internal bristles numerous, yellow. **Tepals** 3–4, reddish, glabrous. **Achenes** oblong, 1–1.3 mm long, keeled, tuberculate.

Distribution. Endemic to Borneo, common in Mt. Kinabalu area in Sabah; very rare in Sarawak, known by 2 collections *S. 17688* from Ulu Anap, Tatau district, and *S. 47783* from G. Pagon Periok, Limbang district. Not known in Brunei and Kalimantan.

Ecology. In hill mixed dipterocarp to lower montane forests, at 1000–1800 m altitude.

18. **Ficus eumorpha** Corner

(Greek, *eu* = good, *morphus* = shape; alluding to the shape of the leaves)

Gard. Bull. Sing. 17 (1960) 439, *l.c.* (1965) 49; Anderson *l.c.* 258; Primack *l.c.* 85; Whitmore, Tantra & Sutisna *l.c.* 245. **Type:** *SFN 27566*, Borneo, Sabah, Tibobah R. (holotype SING).

Dioecious tree, up to 18 m tall. *Twigs*, *leaves and syconia yellowish hairy*. **Twigs** 0.4–0.5 cm thick. **Stipules** up to 1.5 cm long, hairy. **Leaves** *spirally arranged*, coriaceous, *yellowish soft-hairy below*, upper surface rough to the touch; ovate, 8–20 × 6.5–14 cm, *base cordate or truncate*, *margin distinctly toothed*, apex acute; *midrib raised above*; lateral veins 5–7 pairs, raised on both surfaces, basal pair reaching almost 1/2 the length of the blade, *with a gland in each axil below*; intercostal venation scalariform, raised below, faint above; petiole 4–8.5 cm long, powdery yellow-hairy. **Syconia** *axillary*, *sessile*, subglobose to ellipsoid, *1.6–1.7 × 1.4–1.5 cm*, *covered with long hairs*, ripening yellowish green; *basal bracts 3–4 mm long*; internal bristles numerous, 1–2 mm long. **Tepals** 3, white, densely hairy. **Achenes** oblong, 1–1.2 mm long, slightly keeled, subtuberculate.

Vernacular name. Sarawak—*tempan* (Iban).

Distribution. Endemic to Borneo. Rare in Sabah (Mt. Kinabalu) and Sarawak (Mt. Mulu) but locally frequent. Also in Brunei and Kalimantan.

Ecology. In lower montane forest, at 1300–1500 m altitude.

19. **Ficus fistulosa** Reinw. *ex* Blume

(Latin, *fistulosus* = hollow throughout; the young twigs)

Bijdr. Fl. Ned. Ind. (1825) 470; King *l.c.* (1888) 114; Merrill *l.c.* (1921) 223; Ridley *l.c.* (1924) 343; Burkill *l.c.* 1025; Backer & Bakhuizen *f. l.c.* 32; Corner *l.c.* (1965) 93; Kochummen *l.c.* 146; Anderson *l.c.* 258; Primack *l.c.* 85; Whitmore, Tantra & Sutisna *l.c.* 245; Coode *et al.* (eds.) *l.c.* 214. **Type:** *Reinwardt s.n.* (= *RHL Sheet No. 9081881231*), Java (holotype L). **Synonym:** *F. condensa* King *l.c.* (1888) 114.

Dioecious tree, up to 18 m, 20 cm diameter. **Bark** grey; inner bark yellowish white; latex pale yellowish buff. **Twigs** 0.3–0.8 cm thick, *hollow*. **Stipules** up to 1.5 cm long, caducous. **Leaves** *spirally arranged or opposite*, *glabrous*, coriaceous; ovate to lanceolate or elliptic to oblong, 8–25 × 2.5–12 cm, *base rounded*, sometimes asymmetric, *margin entire*, *revolute*, *apex acute*; *midrib raised above*; lateral veins 4–9 pairs, raised below, faint above, basal pair short; intercostal venation reticulate or subscalariform, visible on both surfaces; *petiole* 0.8–7 cm long, *with subnodal gland*. **Syconia** *in clusters*, *axillary or borne on stem and branches*, depressed globose, 1.5–2.5 cm diameter, ripening greenish yellow to pale yellow, base narrowed into a short stalk-like structure; *peduncle 1–1.5 cm long*; basal bracts 3, subtriangular, up to 1 mm long, persistent; internal bristles none. **Tepals** 2 or 3, fused, tubular or collar-like. **Achenes** minutely tuberculate.

Vernacular names. Sarawak—*engkunoh*, *engkuroh*, *kara* (Iban).

Distribution. Assam, Bengal, Burma, S China, Indo-China, Formosa, Hainan, Nicobar Islands, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java, and the Lesser Sunda Islands. Common and widely distributed in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland to lower montane forests, up to 1500 m altitude, often by streams.

Key to varieties

Syconia borne on stem and branches. Leaves at least 5 cm wide. Generally in lowland forest..var. **fistulosa**

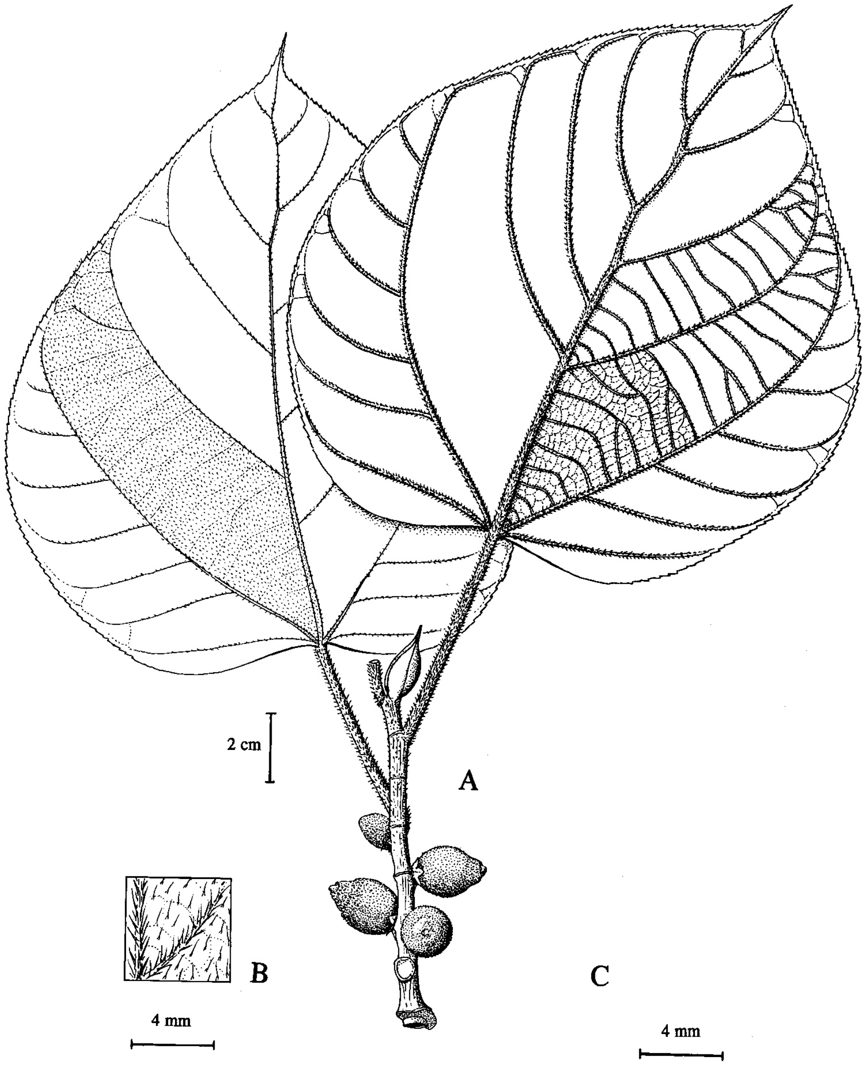

Fig. 9. *Ficus endospermifolia*. A, leafy twig with syconia; B, detail of upper leaf surface; C, detail of lower leaf surface. (A from *Dayang Awa & Lee S. 47983*, B–C from *SAN 113782*.)

Syconia axillary. Leaves 2–3 cm broad. In hill and montane forests...............................

var. **tengerensis** (Miq.) Kuntze

(of Mt. Tengger, E Java)

Rev. Gen. Pl. 1 626. Basionym: *F. tengerensis* Miq. *l.c.* (1867) 283.

Thailand, Sumatra, Peninsular Malaysia, Borneo (Brunei, Kalimantan, Sabah, and Sarawak), and Java.

20. **Ficus francisci** H. Winkl.

(Franz Winkler, brother of H. Winkler)

In Engler, Bot. Jahrb. 49 (1913) 362; Corner *l.c.* (1965) 91; Anderson *l.c.* 258; Primack *l.c.* 86; Whitmore, Tantra & Sutisna *l.c.* 246; Coode *et al.* (eds.) *l.c.* 214. **Type:** unknown.

Dioecious tree, up to 8 m tall, 10 cm diameter. **Twigs** *c.* 0.4 cm thick, *solid*, grey-brown, striate, with distinct stipular and petiolar scars. **Stipules** lanceolate, *c. 1 cm long*, woolly white-hairy, caducous. **Leaves** *spirally arranged*, thin-coriaceous, *drying greenish*, *silky hairy on the midrib*; elliptic to narrowly obovate, 7.5–21.5 × 2–6 cm, *base cuneate to attenuate*, *margin entire*, *plane*, *apex acuminate*, *acumen 1.5 cm long*; *midrib flat above*; lateral veins 8–11 pairs, raised below, faint above, basal pair very short, *with a gland in each axil below*; intercostal venation scalariform; petiole 1.5–4.5 cm long, sparsely hairy. **Syconia** *borne on finger-like leafless branches arising from stem*, *densely or sparsely woolly pubescent*, *glabrescent*, *obovoid*, *c.* 2 × 1 cm (immature), *surface strongly ridged*, apex umbonate with constriction at the base; *peduncle c. 0.7 cm long*; basal bracts 3, glabrous, persistent; internal bristles numerous, white to pale fawn. **Perianth** tubular. **Achenes** lenticular, up to 0.9 mm long, smooth, slightly keeled.

Vernacular name. Sarawak—*entimau* (Iban).

Distribution. Endemic to Borneo; rare in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp forest on alluvial soils.

21. **Ficus fulva** Reinw. *ex* Blume

(Latin, *fulvus* = tawny; the indumentum)

Bijdr. Fl. Ned. Ind. (1825) 478; Miq. *l.c.* (1867) 269; King *l.c.* (1888) 148; Merrill *l.c.* (1921) 223; Ridley *l.c.* (1924) 341; Burkill *l.c.* 1026; Backer & Bakhuizen *f. l.c.* 30; Corner *l.c.* (1965) 46, *l.c.* (1988) 547; Kochummen *l.c.* 147; Anderson *l.c.* 258; Primack *l.c.* 87; Whitmore, Tantra & Sutisna *l.c.* 246; Coode *et al.* (eds.) *l.c.* 214. **Type:** *Blume 44* (= *RHL Sheet No. 925250805*), Java (holotype L). **Synonyms:** *F. chrysocarpa* Reinw. *ex* Blume *l.c.* 475; *F. reinwardtii* Link & Otto, Ic. Pl. Rar. 1 (1828) 6; *F. apiculata* Miq. *l.c.* (1854) 92; *F. suborbicularis* Miq. *l.c.* (1861) 425; *F. flavidula* Miq. *l.c.* (1867) 270; *F. discolor* Miq. *l.c.* (1867) 221; *F. patens* Ridl., J. Str. Br. R. As. Soc. 86 (1922) 306.

Dioecious small tree, rarely up to 20 m tall and 20 cm diameter. **Bark** brown; inner bark yellowish. **Twigs** 0.3–0.8 cm thick, stiff-hairy. **Stipules** lanceolate, *c.* 1 cm long, acute, pale hairy outside. **Leaves** *spirally arranged*, thin-coriaceous, *densely velvety yellowish hairy below*, sparsely hairy above; ovate, elliptic or obovate, 9–27 × 4.5–16 cm, *base symmetric*, *usually cuneate*, *margin faintly toothed*, *apex shortly acute*; *midrib flat above*; lateral veins 4–6 pairs, raised below, faint above, basal pair reaching up to 2/3 the length of the blade, *with a gland in each axil below*; *intercostal venation scalariform*, raised below, faint above; petiole 1.5–5 cm long, sparsely yellowish hairy. **Syconia** *axillary*, *in pairs*, *velvety yellowish hairy*, ovoid to globose, *0.8–1 cm diameter*, apex umbonate; *peduncle up to 0.5 cm long*; basal bracts ovate to rounded, 2–3.5 mm long, persistent, *lateral bracts absent*; internal bristles numerous, up to 1 mm long. **Tepals** 3–5, oblong, glabrous. **Achenes** up to 1 mm long, minutely tuberculate.

Vernacular names. Sarawak—*lengan*, *tempan* (Iban).

Distribution. Nicobar Islands, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, Maluku, Sumbawa, and Timor. Very common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland primary, secondary and degraded forests.

22. **Ficus geocharis** Corner

(Greek, *geos* = earth or ground, *charis* = enchanting; the syconia)

Gard. Bull. Sing. 18 (1960) 60, *l.c.* (1965) 92; Anderson *l.c.* 258; Primack *l.c.* 87; Whitmore, Tantra & Sutisna *l.c.* 246; Coode *et al.* (eds.) *l.c.* 214. **Type:** *Clemens 21912*, Borneo, Sarawak (holotype BM).

Dioecious tree, up to 13 m tall. *Twigs*, *petioles*, *leaf undersurface and syconia yellowish brown hairy*. **Twigs** *c.* 0.3 cm thick, dark brown. **Stipules** lanceolate, 1.5–3.8 cm long, *persistent.* **Leaves** *distichous*, membranous; elliptic to oblong or lanceolate, 15–39 × 5–9 cm, *base asymmetric*, *with one side narrowly cuneate and the other narrowly auriculate*, *margin finely toothed*, apex abruptly acuminate, acumen 2–6 cm long; *midrib raised above*; lateral veins 6–8(–10) pairs, *distal ones with axillary glands*, basal 1–4 pairs short, departing from near the base of midrib; intercostal venation finely raised below; *petiole* 0.4–0.9 cm long, *with subnodal gland*. **Syconia** *borne on stolons arising from the base of stem and also on leafless twigs arising from branches and stems*, ripening purplish, densely yellowish or reddish brown hairy, depressed globose to turbinate, 1.6–2 cm diameter; *peduncle 0.15–0.4 cm long*; lateral bracts lanceolate, up to 9 mm long; internal bristles none. **Perianth** rudimentary or absent. **Achenes** lenticular, up to 0.9 mm long, smooth.

Vernacular names. Sarawak—*buah abung* (Kelabit), *entimau*, *timopada* (Iban).

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan). In Sabah and Sarawak rare; recorded from Sabah by 1 collection *SAN 2864* from Sandakan district (Betotan), and from Sarawak by 4 collections (including the type) from Bau, Kuching, Miri (G. Mulu NP), and Belaga (Upper Rajang) districts.

Ecology. In lowland mixed dipterocarp forest, including limestone habitat.

23. **Ficus glandulifera** (Wall. *ex* Miq.) King Fig. 10.

(Latin, *glanduliferus* = gland-bearing; the petiole)

Ann. Roy. Bot. Gard. Calc. 1, 2 (1888) 143; Ridley *l.c.* (1924) 347; Backer & Bakhuizen *f. l.c.* 29; Corner *l.c.* (1965) 47; Kochummen *l.c.* 147; Anderson *l.c.* 258; Primack *l.c.* 88; Whitmore, Tantra & Sutisna *l.c.* 246; Coode *et al.* (eds.) *l.c.* 215. **Basionym:** *Pogonotrophe glandulifera* Wall. *ex* Miq. *l.c.* (1848) 77. **Type:** *Wall. Cat. 4481* (K). **Synonyms:** *P. aurantiaca* Miq. *in* Zollinger, Syst. Verz. 2 (1854) 93; *P. sumatrana* Miq., Fl. Ind. Bat. Suppl. (1861) 436; *F. aurantiaca* (Miq.) Miq. *l.c.* (1867) 293; *F. hasskarlii* Merr., Philip. J. Sc. 11 (1916) Bot. 264; *F. henschelii* Merr. *l.c.* (1916) 264.

Dioecious tree, up to 30 m tall, 40 cm diameter; buttresses up to 1.5 m high. **Bark** dark brown, smooth and lenticellate; inner bark pale yellow. **Sapwood** yellowish. **Twigs** 0.2–0.4 cm thick, reddish brown. **Stipules** ovate, *c.* 0.5 cm long, densely reddish brown hairy. **Leaves** *spirally arranged*, membranous, *densely or sparsely brownish hairy below*, *very sparsely hairy on midrib and veins above*; elliptic to narrowly obovate, *(5–)8–15.5 × (2.5–)3.5–8 cm*, base cuneate, *margin entire*, *plane*, apex cuspidate or acuminate; *midrib flat above*; *lateral veins 4–6 pairs*, raised below, faint above, basal pair reaching almost 1/2 the length of the blade, *without glands in the axils*; intercostal venation scalariform, distinct below, faint above; *petiole* 1.5–7 cm long, sparsely reddish brown hairy, *usually with a subnodal gland*. **Syconia** *borne on twigs behind the leaves*, ripening yellow to red, subglobose or ellipsoid, *c.* 1 cm diameter, apex slightly convex and perforated, base abruptly narrowed into a short stalk-like structure; *peduncle up to 0.6 cm long*; basal bracts 3, 1.5–2.5 mm long; internal bristles numerous, 1–2 mm long, yellowish. **Tepals** 3–5, narrowly spathulate. **Achenes** 1–1.5 mm long, rugose, strongly keeled.

Distribution. Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Maluku, and New Guinea. Widely distributed in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland to lower montane forests, up to 1400 m altitude.

Key to varieties

Leaves sparsely hairy below..var. **glandulifera**
Leaves densely velvety hairy below...

var. **villosa** Corner
(Latin, *villosus* = shaggy with long soft straight ascending hairs; the lower leaf surface)
Gard. Bull. Sing. 17 (1960) 433, *l.c.* (1965) 47; Whitmore, Tantra & Sutisna *l.c.* 246. Type: *NGF 3753*, New Guinea, Sepik district (holotype LAE).
Borneo, Morotai and Papua New Guinea. In Sabah very rare, known only by 1 collection, *SAN 2930*. Not known in Sarawak, Brunei and Kalimantan.

24. **Ficus grossularioides** Burm. *f.*

(Latin *grossularioides* = like the gooseberry, *Ribes grossularia*; the shape of syconia)

Fl. Ind. (1768) 227; Backer & Bakhuizen *f. l.c.* 30; Corner *l.c.* (1965) 44, *l.c.* (1988) 547; Kochummen *l.c.* 148; Anderson *l.c.* 259; Primack *l.c.* 89; Whitmore, Tantra & Sutisna *l.c.* 247; Coode *et al.* (eds.) *l.c.*

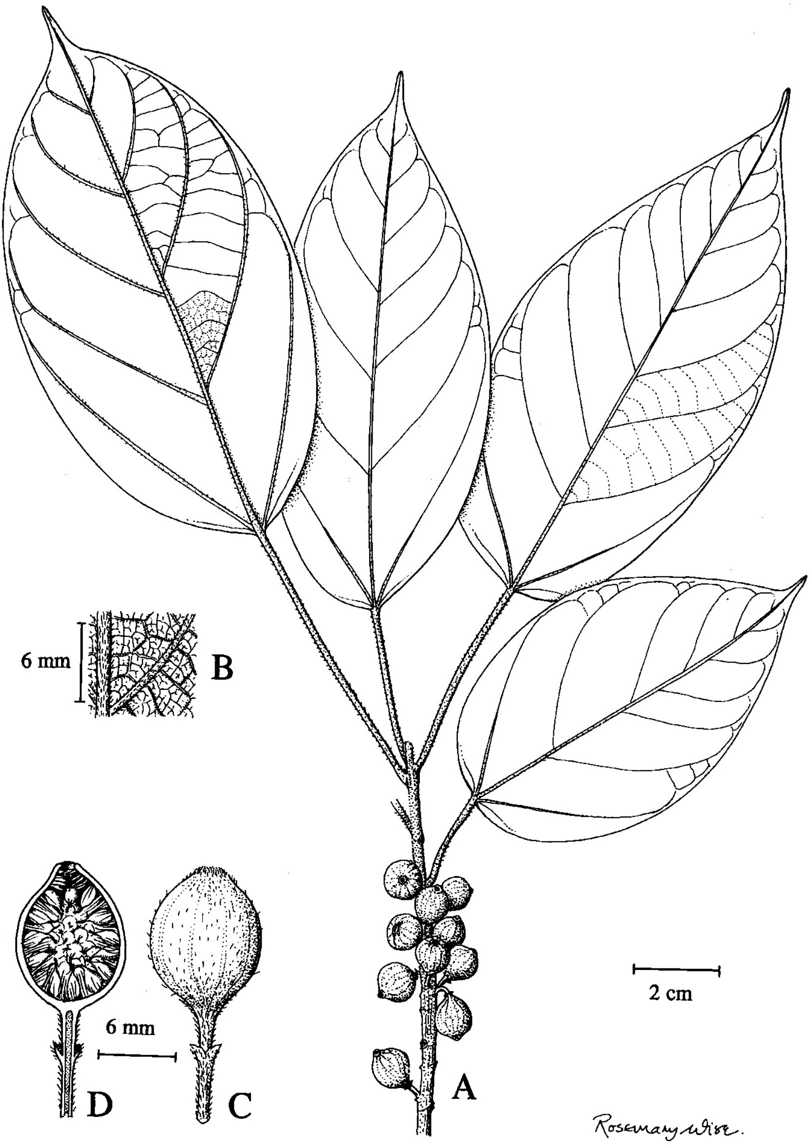

Fig. 10. *Ficus glandulifera*. A, leafy twig with syconia; B, detail of lower leaf surface; C, syconium; D, longitudinal section of syconium. (From *SAN 102474*.)

215. **Type:** unknown. **Synonyms:** *F. alba* Reinw. *ex* Blume *l.c.* 467; *F. nivea* Blume *l.c.* 476; *F. palmata* Roxb., Fl. Ind., ed. Carey, 3 (1832) 529; *F. hunteri* Miq. *l.c.* (1848) 225; *F. chloroleuca* Miq. *l.c.* (1859) 294; *F. gossypina* Wall. *ex* Miq. *l.c.* (1861) 425; *F. mappan* Miq. *l.c.* (1861) 425; *F. alba* Reinw. *ex* Blume var. *gossypina* (Wall. *ex* Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 626; *F. alba* Reinw. *ex* Blume var. *nudinervis* Kuntze *l.c.* (1891) 626; *F. lobata* Hunter *ex* Ridl., J. Str. Br. R. As. Soc. 53 (1909) 123.

Dioecious tree, up to 13 m tall, 15 cm diameter. **Twigs** 0.2–0.5 cm thick, reddish brown, glabrous. **Stipules** pale hairy, lanceolate, acute, *c.* 0.5 cm long. **Leaves** *spirally arranged*, thin-coriaceous, *glaucous and velvety hairy below*, *very rough-hairy above*; elliptic to obovate, 5.5–19 × 3.5–11.5 cm, base cuneate, *margin entire*, *lobed or distinctly toothed*, apex acute; *midrib sunken above*; lateral veins 4–6 pairs, *sunken above*, raised below, basal pair reaching about 1/2 the length of the blade, *with a gland in each axil below*; intercostal venation scalariform to reticulate, visible below, invisible above; petiole 1.5–11.5 cm long, pinkish on drying. **Syconia** *axillary*, *sessile*, *in pairs*, ripening yellowish brown, ellipsoid to subglobose, 0.8–1 cm diameter, apex umbonate; basal bracts ovate, 1–2.5 mm long; internal bristles few, short, white. **Tepals** 3 or 5, glabrous. **Achenes** *c.* 1 mm long, tuberculate.

Vernacular names. Sarawak—*kumpan*, *lenakan*, *lelingkan*, *lengkan* (Iban), *kukan* (Bidayuh).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, and Java. Common in Sarawak, not yet reported for Sabah. Also in Brunei and Kalimantan.

Ecology. In primary and secondary lowland forests.

25. **Ficus gul** K. Schum. & Lauterb.

(local name of the plant in Papua New Guinea—*gul*)

Fl. Schutzgeb. (1901) 278; Corner *l.c.* 17 (1960) 452, *l.c.* (1965) 63; Whitmore, Tantra & Sutisna *l.c.* 247. **Type:** unknown. **Synonyms:** *F. rudis* Miq. *l.c.* (1867) 222; *F. manilensis* Warb. *in* Perkin, Fragm. Fl. Philip. 3 (1905) 199.

Dioecious tree, up to 22 m tall, 30 cm diameter. **Bark** grey-brown, smooth; inner bark pale. **Sapwood** pale. **Twigs** 0.2–0.35 cm thick, slender, initially rough-hairy. **Stipules** lanceolate, acute, *c.* 0.5 cm long, hairy outside, caducous. **Leaves** *spirally arranged*, thin-coriaceous, *rough-hairy on both surfaces*; elliptic to oblong or obovate, 8–17.5 × 3.8–8.5 cm, *base symmetric*, *cuneate*, *margin toothed*, *apex acute*; *midrib flat above*; lateral veins 5–7 pairs, with short intermediate veins in between, faintly raised below, very faint above, basal pair extending to nearly 1/2 the length of the blade, *with a gland in each axil below*; intercostal venation scalariform, faint on both surfaces; petiole 1.5–5.5 cm long, sparsely rough-hairy. **Syconia** hairy, *in clusters*, *axillary or borne on twigs behind the leaves*, globose, *0.4–0.6 cm diameter*, ripening dull red-purple, apex umbonate; *peduncle slender*, *c. 1 cm long*; basal bracts absent, *lateral bracts triangular*, *many*; internal bristles numerous, *c.* 0.3 mm long, white. **Tepals** (3–)4–5, dark red, free, glabrous. **Achenes** *c.* 0.8 mm long, compressed, smooth, slightly keeled.

Distribution. Borneo, the Philippines, Sulawesi, Maluku, Tanimbar, Key Is., Flores, New

Guinea, Admiralty Islands, and New Britain. Widely distributed in Sabah, not yet recorded for Sarawak. Not known in Brunei and Kalimantan.

Ecology. In lowland and hill forests.

26. **Ficus hemsleyana** King

(W.B. Hemsley, 1843–1924, sometime botanist and keeper of the Herbarium, Royal Botanic Gardens Kew, U.K.)

Ann. Roy. Bot. Gard. Cal. 1, 2 (1888) 112; Merrill *l.c.* (1921) 224; Corner *l.c.* (1965) 79; Anderson *l.c.* 259; Primack *l.c.* 89; Whitmore, Tantra & Sutisna *l.c.* 247; Coode *et al.* (eds.) *l.c.* 214. **Type:** *Beccari PB 2335*, Borneo, Sarawak (FI).

Dioecious tree, up to 12 m tall, 20 cm diameter, or climber. **Twigs** *c.* 0.3 cm thick, grey-white, slightly angled, covered with reddish brown hairs. **Stipules** lanceolate, acute, 1.5–1.8 cm long, brown hairy, *subpersistent*. **Leaves** *spirally arranged*, thin-coriaceous, *sessile*, *reddish brown hairy below* to almost glabrous; oblong, 19–35 × 5–13 cm, *base distinctly auriculate on one side*, *margin toothed*, apex acuminate, acumen 4–5 cm long; *midrib raised above*, keeled below; *lateral veins* 7–10 pairs, steeply ascending, raised below, *sunken above*, basal pairs extending to almost 1/2 the length of the blade, *with a gland in each axil below*; intercostal venation reticulate to scalariform, visible below, distinctly sunken above. **Syconia** *in clusters on tubercles arising from the stem*, globose, 0.4–0.6 cm diameter, ripening orange, glabrous or hairy, apex depressed; *peduncle 0.7–1.5 cm long*; basal bracts 2–3, minute; internal bristles few, minute. **Tepals** 3–5, oblong or ligulate, free or slightly joined at the base, white to red-brown. **Achenes** ovoid, *c.* 1.5 mm long, distinctly keeled at the apex.

Vernacular names. Sarawak—*kara* (Iban), *lunok* (Kenyah).

Distribution. Endemic to Borneo. Common in Sarawak; rare in Sabah, known by a single collection, *SAN A 4417*, from Kota Belud district. Also in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp to lower montane forests, including limestone habitat, up to 1600 m altitude, often by streams.

27. **Ficus ixoroides** Corner

(like *Ixora*, a genus in the Rubiaceae)

Gard. Bull. Sing. 18 (1960) 63, *l.c.* (1965) 94; Whitmore, Tantra & Sutisna *l.c.* 247. **Type:** *Beccari PB 2781*, Borneo, Sarawak (FI).

Dioecious shrub, *without free hanging aerial roots*. **Twigs** *c.* 0.2 cm thick, dark brown. **Stipules** lanceolate, *c.* 2 cm long, glabrous, caducous. **Leaves** *decussate or spirally arranged*, subcoriaceous, *glabrous*, drying greenish; *lanceolate or narrowly oblong*, *6–18 × 1.2–3.2 cm*, *base symmetric*, *cuneate*, *margin entire*, *plane*, *apex acute*; *midrib raised above*; *lateral veins 8–16 pairs*, *well-spaced*, *curved*, *forming a broad angle with the midrib*, faintly raised on both surfaces, with short intermediate veins in between, joining near the leaf margin, *basal pair distinct*; intercostal venation obsure; *petiole* 0.5–1.5 cm long, *with a subnodal gland*. **Syconia** *solitary*, *axillary*, glabrous, subglobose, *c.* 1 cm diameter, *tapered at the base*, apex flat; *peduncle 0.2–0.4 cm long*; basal bracts 3, *c.* 1 mm long, lateral bracts absent, apical bracts 5, small; internal bristles absent. **Perianth** tubular, reddish brown. **Achenes** subtuberculate, not keeled.

Distribution. Endemic to Borneo. Rare in Sabah and Sarawak, known by 1 collection each. Also in Kalimantan.

Ecology. In riparian forest.

28. **Ficus lamponga** Miq.

(of Lampong, Sumatra)

Fl. Ind. Bat., Suppl. (1861) 431; Corner *l.c.* (1965) 47; Kochummen *l.c.* 150; Anderson *l.c.* 259; Primack *l.c.* 91; Whitmore, Tantra & Sutisna *l.c.* 248. **Type:** *Teijsmann s.n.*, Sumatra, Lampong, Tarabangi Agong (U?). **Synonyms:** *F. lepidosa* Wall. *ex* Kurz, J. As. Soc. Beng. 42 (1873) 107; *F. balansae* Gagnep., Not. Syst. 4 (1927) 86.

Dioecious tree, up to 30 m tall, 50 cm diameter, *without free hanging aerial roots*. **Bark** reddish brown. **Twigs** 0.2–0.4 cm thick, dark brown with prominent stipular scars. **Stipules** ovate, 0.5–1.2 cm long, glabrous, caducous. **Leaves** *spirally arranged*, membranous, *glabrous on both surfaces*; *elliptic to oblong*, *9–12.5 × 2.5–4.5 cm*, *base symmetric*, *cuneate*, *margin entire*, *plane*, *apex acute*; *midrib raised above*; *lateral veins 7–13 pairs*, *well-spaced*, *curved*, *not steeply ascending*, raised on both surfaces, *basal pair distinct*, *without axillary glands*; *intercostal venation reticulate*, visible below, invisible above; *petiole 1.5–2.5 cm long*. **Syconia** *in pairs on twigs behind leaves*, ripening orange to red, globose to ellipsoid, 0.8–1.3 cm diameter, base tapered, apex umbonate; *peduncle up to 1.5 cm long*; basal bracts 2, 2–3 mm long; internal bristles numerous, *c.* 1 mm long, yellow. **Tepals** 3–4, spathulate. **Achenes** oblong, *c.* 1 mm long, rugose, strongly keeled.

Vernacular names. Sarawak—*ara*, *tempan* (Iban).

Distribution. Assam, Burma, Indo-China, Thailand, Andaman Islands, Sumatra, Peninsular Malaysia, Borneo, and Sulawesi. Very rare in Sabah, known by a single collection, *SAN 31975*, from Beaufort district. In Sarawak, recorded for Kapit, Lundu and Samarahan (G. Buri) districts. Not known in Brunei and Kalimantan.

Ecology. In lowland to lower montane forests, up to 1200 m altitude.

29. **Ficus lepicarpa** Blume

(Greek, *lepis* = scales, *karpos* = fruits; the occurrence of scale-like bracts on the surface of syconia)

Bijdr. Fl. Ned. Ind. (1825) 459; Miquel *l.c.* (1867) 283; King *l.c.* (1888) 118; Merrill *l.c.* (1921) 224; Ridley *l.c.* (1924) 343; Burkill *l.c.* 1028; Backer & Bakhuizen *f. l.c.* 33; Corner *l.c.* (1965) 90, *l.c.* (1988)

548; Kochummen *l.c.* 150; Anderson *l.c.* 259; Primack *l.c.* 91; Whitmore, Tantra & Sutisna *l.c.* 248; Coode *et al.* (eds.) *l.c.* 215. **Type:** *Blume s.n.*, Java (L?). **Synonyms:** *Covellia volkameriaefolia* Wall. *ex* Miq. *l.c.* (1848) 464; *C. didyma* Miq. *l.c.* (1851) 65; *C. lepicarpa* (Blume) Miq. *l.c.* (1859) 328; *F. malaica* Hunter *ex* Ridl., J. Str. Br. Roy. As. Soc. 53 (1909) 123; *F. lepicarpa* Blume var. *brevipedunculata* Corner *l.c.* 18 (1960) 54; *F. lepicarpa* Blume var. *brevibracteata* Corner *l.c.* 18 (1960) 54; type: *Haviland s.n.*, Sarawak (K), *syn. nov.*

Dioecious tree, up to 10 m tall, 10 cm diameter, *without free hanging aerial roots*; buttresses short. **Bark** greyish brown. **Twigs** *c.* 0.4 cm thick, grey-brown, angled, with prominent grooves. **Stipules** lanceolate, acute, 1–2 cm long, persistent on twig ends. **Leaves** *spirally arranged*, thin-coriaceous, *glabrous on both surfaces*; *oblanceolate*, *9–25 × 3–11.5 cm*, *base symmetric*, *cuneate*, *margin entire*, *plane*, *apex acute*; *midrib raised above*, *rounded below*; *lateral veins 8–10 pairs*, *well-spaced*, *curved*, *departing from the midrib at a broad angle*, raised below, faint above, *basal pair distinct*, *without axillary glands*; *intercostal venation scalariform*, visible below, faint above; petiole 1.5–5 cm long. **Syconia** *axillary*, *sessile*, ripening pale yellow to brownish, obovoid to subglobose, 1.2–1.5 × 1–1.2 cm; *basal bracts 3*, 4–13 mm long, *lateral bracts present*; internal bristles absent. **Tepals** fused into tubular perianth. **Achenes** *c.* 1 mm long, tuberculate, rough, keeled.

Vernacular names. Sarawak—*engkusuroh*, *kara* (Iban).

Distribution. Burma, Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, the Philippines, Sulawesi, and Ambon. Common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland forest by streams.

30. **Ficus leptocalama** Corner

(Greek, *lepto* = slender, *kalamos* = stalk; the slender-stalked syconia)

Gard. Bull. Sing. 17 (1960) 483, *l.c.* (1965) 79; Whitmore, Tantra & Sutisna *l.c.* 248; Coode *et al.* (eds.) *l.c.* 215. **Type:** *SFN 26829*, Borneo, Sabah, Mt. Kinabalu, Menetendok R. (holotype SING).

Dioecious small tree, up to 5 m tall. **Twigs** slender, *c.* 0.1 cm thick, pale reddish yellow. **Stipules** *c.* 0.8 cm long, subpersistent. **Leaves** *distichous*, thin-coriaceous, *glabrous*; elliptic, 8–15 × 2.5–4.5 cm, *base symmetric*, *cuneate or auriculate*, *margin entire*, *plane*, *apex caudate*, *acumen up to 3 cm long*; *midrib raised above*, *rounded below*; *lateral veins 7–10 pairs*, *well-spaced*, *curved*, *basal pair distinct*, *with a gland in one or both axils below*; *petiole 0.1–0.3 cm long*. **Syconia** *solitary or in pairs*, *borne on twigs behind the leaves or on stolons arising from the base of the stem*, *or on short drooping leafless branches arising from near the base of the stem*, ripening rose-pink to red, subglobose, 0.6–0.8 cm diameter, *base tapered into a stalk 0.1–0.2 cm long*; basal bracts 2–3, minute, *lateral bracts present*; internal bristles absent. **Tepals** 4, white, free or slightly united at the base, glabrous. **Achene** oblong, *c.* 1.2 mm long, slightly compressed, not keeled, smooth.

Distribution. Endemic to Borneo. In Sabah very rare, known by the type only from Mt. Kinabalu; not known in Sarawak. Also in Brunei and Kalimantan.

Ecology. In hill mixed dipterocarp forest, up to 1000 m altitude.

31. **Ficus leptogramma** Corner

(Greek, *lepto* = slender, *gramma* = streaks or lines; the striate stipules)

Gard. Bull. Sing. 17 (1960) 473, *l.c.* (1965) 73; Anderson *l.c.* 259; Primack *l.c.* 92; Whitmore, Tantra & Sutisna *l.c.* 249. **Type**: *SFN 27328*, Borneo, Sabah, Mt. Kinabalu (holotype SING).

Dioecious tree, up to 12 m tall, 30 cm diameter. **Bark** dark grey, smooth. **Twigs** *c.* 0.3 cm thick, light greyish brown, sulcate or striate. **Stipules** paired, lanceolate, up to 1.5 cm long, glabrous, *longitudinally striate*, subpersistent. **Leaves** *distichous*, coriaceous, *glabrous*; elliptic to subovate, 10–35 × 2.7–14 cm, base rounded or cuneate, *margin lobed or faintly toothed*, *apex caudate*, *acumen up to 6 cm long*; *midrib raised above*; lateral veins 8–12 pairs, with short intermediate veins in between, *sunken above*, raised below, basal pair short, *with a gland in each axil below*; intercostal venation scalariform or reticulate, *sunken above*; petiole 0.3–2.5 cm long. **Syconia** *borne in clusters on stem and branches*, ripening olive tinted purple to dark crimson, subglobose to ellipsoid, 1–1.5 × 1–1.2 cm, apex umbonate; *peduncle 1–2.5 cm long*; basal bracts absent, *lateral bracts many* and scattered; internal bristles absent. **Tepals** 3–8, white or pinkish, free or slightly joined at the base, glabrous. **Achenes** lenticular, *c.* 1 mm long, slightly compressed, not keeled.

Distribution. Endemic to Borneo. Very rare in Sabah, more frequent in Sarawak. Not known in Brunei and Kalimantan.

Ecology. In lowland to hill mixed dipterocarp forests, including limestone habitat, up to 1200 m altitude.

32. **Ficus macilenta** King

(Latin, *macilentus* = thin; the leaves)

Ann. Roy. Bot. Gard. Calc. 1, 2 (1888) 155; Merrill *l.c.* (1921) 224; Corner *l.c.* (1965) 49; Primack *l.c.* 92; Whitmore, Tantra & Sutisna *l.c.* 249. **Type:** *Beccari PB 1696*, Borneo, Sarawak (FI).

Dioecious tree, up to 8 m tall, 10 cm diameter. **Twigs** 0.3–0.5 cm thick, yellowish hairy, glabrescent. **Stipules** lanceolate, *c.* 0.8 cm long, *glabrous* or hairy, caducous. **Leaves** *spirally arranged*, *thin-coriaceous*, drying greenish yellow, *glabrous or sparsely to densely hairy below*, rough-hairy above; elliptic to rhomboid, 3.5–19 × 1.5–10 cm, base cuneate, *margin entire and plane*, *or distantly shallowly lobed or toothed*, apex acuminate, acumen up to 1.5 cm long; *midrib sunken above*; lateral veins 5–7 pairs, raised below, faint above, curving and joining near the leaf margin, basal pair short, *sometimes with a gland in each axil below*; intercostal venation reticulate, distinct below, faint to invisible above; petiole 0.5–2 cm long, glabrous or hairy. **Syconia** *axillary*, *solitary or in pairs*, *sessile or with short peduncle*, densely hispid with stiff brown hairs, ripening red, ellipsoid or subglobose, 0.5–2 cm diameter, glabrous or hairy; basal and apical bracts tiny; internal bristles numerous, 1–2 mm long, white. **Tepals** 3–4, long-hairy, white. **Achenes** *c.* 1 mm long, tuberculate, slightly keeled.

Vernacular names. Sarawak—*talatad* (Kelabit), *tempan* (Iban).

Distribution. Endemic to Borneo. Uncommon in Sabah and Sarawak. Also in Brunei.

Ecology. In hill mixed dipterocarp to upper montane forests, at 800–2000 m altitude.

Key to varieties

1. Leaves densely velvety hairy below. Syconia sessile..........................var. **macilenta**
   Leaves sparsely hairy or glabrous below. Syconia short-peduncled..........................2

2. Upper half of leaves strongly lobed. Syconia solitary..
   var. **ilicifolia** Corner
   (Latin, *ilicifolius* = with leaves resembling those of holly tree—*Ilex*)
   Gard. Bull. Sing. 17 (1960) 439, *l.c.* (1965) 49; Whitmore, Tantra and Sutisna *l.c.* 249. Type: *SFN 26952*, Borneo, Sabah, Ranau district, Mt. Kinabalu (holotype SING).
   Differs from the other varieties in the short-pubescent, lobed leaves and solitary syconia.
   Endemic to Borneo; rare and confined to Mt. Kinabalu in Sabah. In lower to upper montane forests, at 1500–2000 m altitude.
   Leaf margin entire, plane or faintly distantly toothed. Syconia in pairs..........................
   var. **gibbsiae** (Ridl.) Corner
   (L.S. Gibbs, 1870–1925, the British botanist)
   Gard. Bull. Sing. 17 (1960) 439, *l.c.* (1965) 49; Whitmore, Tantra & Sutisna *l.c.* 249; Coode *et al.* (eds.) *l.c.* 215. Basionym: *F. gibbsiae* Ridl., J. Linn. Soc. Bot. 42 (1915) 137. Type: unknown.
   Differs from var. *macilenta* in the peduncled syconia and less hairy leaves and syconia.
   Endemic to Borneo. Rare in Sabah, more common in Sarawak. Also in Brunei. In hill mixed dipterocarp to lower montane forests, at 800–1300 m altitude.

33. **Ficus macrostyla** Corner

(Greek, *makro* = large or long, Latin, *stylus* = style; the long-styled female flowers)

Gard. Bull. Sing. 18 (1960) 43, *l.c.* (1965) 85; Whitmore, Tantra & Sutisna *l.c.* 249. **Type:** *Haviland 3601*, Borneo, Sarawak (K).

Dioecious shrub. **Twigs** *c.* 0.3 cm thick, dark brown, with large stipular scars, hairy. **Stipules** narrowly lanceolate, up to 1.5 cm long, *yellowish hairy*, persistent. **Leaves** *spirally arranged*, coriaceous, *glabrous or yellowish brown hairy below*; obovate or oblanceolate, 6.5–21 × 2.5–5.5 cm, *base attenuate*, *margin entire*, *revolute*, *apex obtuse*; *midrib raised above*; lateral veins 8–11 pairs, with short intermediate veins in between, raised on both surfaces, *basal pair distinct*, *departing from the midrib at an acute angle*, *without gland in the axils below*; intercostal venation reticulate, distinct below, invisible above; petiole 1.2–4 cm long, *yellowish brown hairy*. **Syconia** *axillary or borne on twigs behind the leaves or on stolons*, hairy, ovoid, *c.* 1.7 × 0.6 cm, *surface completely covered with long*, *flat*, *straight*, *appressed*, *brown-hairy bracts*; internal bristles few, short, brown. **Perianth** cup-shaped. **Achenes** *c.* 1 × 0.6 mm, subcompressed, smooth, strongly keeled.

Distribution. Endemic to Borneo, and confined to Sarawak, gregarious where it occurs.

Ecology. In lowland mixed dipterocarp forest by streams.

Use. Figs edible.

34. **Ficus magnoliifolia** Blume

(with leaves like that of *Magnolia*, Magnoliaceae)

Bijdr. Fl. Ned. Ind. (1825) 448; Miquel *l.c.* (1867) 263; Backer & Bakhuizen *f. l.c.* 27; Corner *l.c.* (1965) 31; Kochummen *l.c.* 151; Anderson *l.c.* 259; Primack *l.c.* 93; Whitmore, Tantra & Sutisna *l.c.* 249. **Type:** *Blume s.n.*, Java (L?). **Synonyms:** *Urostigma modestum* Miq. *l.c.* (1851) 5; *U. euneuron* Miq. *l.c.* (1859) 599; *F. nervosa* (*non* Heyne *ex* Roth) Elmer, Leaft. Philip. Bot. 2 (1908) 537; *F. apoensis* Elmer, Leafl. Philip. Bot. 4 (1911) 1249.

Monoecious tree, up to 45 m tall, 70 cm diameter; buttresses up to 2 m tall. **Bark** grey-brown, smooth to scaly; inner bark brown; latex citron-yellow, acrid, poisonous. **Sapwood** yellowish. **Twigs** *c.* 0.3 cm thick, dark brown, irregularly grooved on drying. **Stipules** narrowly lanceolate, acute, *c.* 0.8 cm long, caducous. **Leaves** *spirally arranged or distichous*, *coriaceous*, *glabrous*, brownish on drying; *oblong*, *9–20 × 2.5–8.5 cm*, base cuneate, *margin entire*, *plane*, *apex acute to acuminate*, acumen up to 2.5 cm long; *midrib sunken above*; *lateral veins* 10–12 pairs, *flat to slightly raised above*, prominent below, distinctly curving and joining near the leaf margin, with shorter veins in between, basal veins short, *with a gland in each axil below*; intercostal venation reticulate, faintly visible on both surfaces; *petiole 0.5–0.8 cm long*. **Syconia** *axillary*, *solitary or paired*, globose, 1.5–1.8 cm diameter, apex with small aperture; *peduncle up to 1.5 cm long*; basal bracts 3, ovate 1–2 mm long; internal bristles absent. **Tepals** 2–4, red, free or somewhat fused, glabrous. **Achene** 1.2–1.4 mm long, smooth, slightly keeled.

Vernacular names. Sarawak—*lumau* (Iban), *puro* (Kayan).

Distribution. Nicobar and Andaman Islands, Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, and the Philippines. Very rare in Sabah and Sarawak, known by 1 collection, *SAN 33972*, from Sabah and a few from Sarawak. Also in Kalimantan.

Ecology. In lowland forest.

35. **Ficus megaleia** Corner

(Greek, *mega* = large, *leios* = smooth to the touch; probably referring to the leaves)

Gard. Bull. Sing. 18 (1960) 57, *l.c.* (1965) 91; Whitmore, Tantra & Sutisna *l.c.* 249; Coode *et al.* (eds.) *l.c.* 216. **Type:** *Corner BRUN 5301*, Borneo, Brunei, Ulu Belalong (holotype CGE).

Dioecious tree, up to 7 m tall, with drooping young twigs. *Twigs*, *stipules*, *petioles and leaf undersurface covered with 1–1.5 mm long, reddish brown or yellowish hairs*. **Twigs** 0.4–0.7 cm thick. **Stipules** oblong, 3–7 cm long, *caducous*. **Leaves** *distichous*, pubescent with rough short hairs above, subcoriaceous or chartaceous; elliptic to oblong, 40–100 × 14–35 cm, *base asymmetric*, *cordate*, *margin finely toothed*, apex caudate or acuminate, acumen 2.5–4 cm long; *midrib flat above*; *lateral veins 10–24 pairs*, raised below, visible above, *basal veins 6–7*, *short*, *mostly with a gland in each axil below*; intercostal venation scalariform, raised below, faint above; *petiole 1–2.5 cm long*. **Syconia** *borne on long stolons arising from the base of stem*, globose, 3–4 cm diameter, densely stiff-hairy, glabrescent, *covered with many ovate-lanceolate bracts*; internal bristles absent. **Perianth** absent or rudimentary. **Achenes** *c.* 0.7 mm long, slightly keeled, slightly ridged.

Distribution. Endemic to Borneo. Rare in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In hill mixed dipterocarp to lower montane forests, at 800–1400 m altitude.

Key to varieties

1. Syconia glabrous...

    var. **subuncinata** Corner

    (Latin, *subuncinatus* = somewhat barbed or hooked; the twigs and petioles)

    Gard. Bull. Sing. 19 (1962) 400, *l.c.* (1965) 91; Whitmore, Tantra & Sutisna *l.c.* 249. Type: *RSNB 1576*, Borneo, Sabah, Mt. Kinabalu (holotype K).

    Very similar to var. *megaleia* differing in the glabrous syconia.

    Endemic to Mt. Kinabalu in Sabah; in lower montane forest at *c.* 1500 m altitude.

   Syconia hairy...2

2. Hairs yellowish, up to 1 mm long; lateral veins 14–24 pairs.......................................

    var. **multinervia** Corner

    (Latin, *multinervius* = with many lateral veins; the leaves)

    Gard. Bull. Sing. 19 (1962) 400, *l.c.* (1965) 91; Whitmore, Tantra & Sutisna *l.c.* 249. Type: *RSNB 970*, Borneo, Sabah, Mt. Kinabalu (holotype K).

    Leaves very much bigger than the typical variety. The hanging pink leaves are conspicuous. Hairs yellowish, dense, up to 1 mm long; lateral veins 14–24 pairs, with 4–6 basal veins.

    Endemic to Borneo, and confined to Mt. Kinabalu, Sabah; in hill mixed dipterocarp forest up to 900 m altitude.

   Hairs reddish brown, more than 1 mm long; lateral veins 10–20 pairs.......var. **megaleia**

36. **Ficus melinocarpa** Blume

(Greek, *melinos* = yellowish, *karpos* = fruit; the ripe syconia)

Bijdr. Fl. Ned. Ind. (1825) 460; King *l.c.* (1888) 94; Backer & Bakhuizen f. *l.c. 29;* Corner *l.c.* (1965) 68; Whitmore, Tantra & Sutisna *l.c.* 249. **Type:** *Blume s.n.* (= *RHL Sheet No. 9081881059*), Java, Mt. Salak (L). **Synonyms:** *F. daemonum* Zoll. & Moritzi, Syst. Verz. (1846) 77; *Pogonotrophe alnifolia* Miq. *l.c.* (1851) 51; *F. obliqua* (*non* Koen. *ex* Vahl) Miq. *l.c.* (1854) 92; *F. alnifolia* (Miq.) Miq. *l.c.* (1867) 278; *F. haggeri* Merr., Philip. J. Sc. 18 (1921) 62; *F. irosinensis* Elmer, Leafl. Philip. J. Sc. (1921) 62.

Dioecious tree, up to 35 m tall, deciduous; buttresses up to 4 m tall, 2 m wide. **Bark** grey-brown; inner bark whitish. **Twigs** *c.* 0.3 cm thick, dark brown, rough-hairy at the tip, slightly hollow. **Stipules** lanceolate, up to 1.2 cm long, rough-hairy, caducous. **Leaves** *distichous*, thin-coriaceous, *smooth and sparsely yellowish hairy on both surfaces*; elliptic or subovate, 7–17.5 × 3.5–9 cm, *base broadly cuneate*, *margin typically distantly toothed*, rarely entire and revolute, *apex obtuse*; *midrib raised above*; lateral veins 6–8 pairs, with shorter veins in between, raised on both surfaces, basal pairs 1–3, extending up to 1/2 the length of the blade, *occasionally with a gland in each axil below*; intercostal venation scalariform to reticulate, distinct below, faint above; *petiole* 1–2 cm long, *rough-hairy.* **Syconia** *axillary or borne on twigs behind the leaves*, short-hairy, glabrescent, ripening yellow, orange, red to purple black, globose to pear-shaped, *0.7–1.2 cm diameter*, apex umbonate, slightly perforate; *peduncle 0.5–0.7 cm long*; basal bracts 3, small; internal bristles numerous, minute. **Tepals** 3–6, reddish pink, free, glabrous. **Achenes** lenticular, up to 1 mm long, almost smooth, scarcely keeled.

Distribution. Sumatra, Java, Borneo, Sulawesi, the Philippines, Maluku, New Guinea, New Britain, and Solomon Islands. Common in Sabah, not yet recorded for Sarawak. Not known in Brunei and Kalimantan.

Ecology. In hill forest, up to 400 m altitude.

37. **Ficus microcarpa** L. *f.*

(Greek, *mikro* = small, *karpos* = fruit; with small syconia)

Sp. Pl., Suppl. (1781) 442; Backer & Bakhuizen *f. l.c.* 24; Corner *l.c.* (1965) 22, *l.c.* (1988) 542; Kochummen *l.c.* 151; Anderson *l.c.* 259; Primack *l.c.* 93; Whitmore, Tantra & Sutisna *l.c.* 250; Coode *et al.* (eds.) *l.c.* 216. **Type:** unknown. **Synonyms:** *F. littoralis* Blume *l.c.* 455; *Urostigma microcarpum* (L. *f.*) Miq. *l.c.* (1847) 583; *U. amblyphyllum* Miq. *l.c.* (1847) 569; *U. pisiferum* Miq. *l.c.* (1847) 580; *F. amblyphylla* (Miq.) Miq. *l.c.* (1867) 286; *F. retusa* L. var. *pisifera* (Miq.) Miq. *l.c.* (1867) 288.

Monoecious tree (or strangler), up to 30 m tall, 40 cm diameter, *with abundant free hanging aerial roots*. **Bark** grey. **Twigs** *c.* 0.3 cm thick, dark brown. **Stipules** glabrous, lanceolate, acuminate, up to 1.5 cm long. **Leaves** *distichous*, coriaceous, *glabrous*; elliptic to obovate, 4–9 × 2–4.5 cm, *base symmetric*, *cuneate*, *margin entire*, *plane*, *apex acute*; *midrib flat above*, *often pale coloured below when dry*; *lateral veins 4–6 pairs*, *well-spaced*, *curved*, *steeply ascending*, looping and joining near the leaf margin, with few equally prominent shorter veins in between, visible below, invisible above, *basal pair distinct*, *reaching up to 1/3–1/2 the length of the blade*, *without axillary glands below*; intercostal venation invisible; petiole 0.4–1 cm long, grooved on the adaxial side. **Syconia** *axillary*, *sessile*, *in pairs*, dark red when ripe, globose, 0.5–0.7 cm diameter, apex umbonate; basal bracts ovate to lanceolate, 1.5–3.5 × 1.5–2.5 mm, apex rounded, persistent; internal bristles few to numerous, up to 0.5 mm long. **Tepals** 3–4, spathulate or obovate, free. **Achenes** oblong, *c.* 2 × 1 mm, smooth, with pink dots.

Vernacular name. Sarawak—*lunok* (Murut).

Distribution. Cocos and Christmas Islands, Sri Lanka, India, S China, Ryu-Kyu, throughout Malesia, New Britain, Australia, and Caroline Islands. Common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. Lowland forest by streams, coastal and swamp forest, often planted in urban areas.

38. **Ficus midotis** Corner

(meaning obscure)

Gard. Bull. Sing. 17 (1960) 482, *l.c.* (1965) 79; Primack *l.c.* 94; Whitmore, Tantra & Sutisna *l.c.* 250. **Type:** *SFN 26324*, Borneo, Sabah (holotype SING).

Dioecious tree, up to 10 m tall (or epiphyte). **Twigs** up to 0.25 cm thick, yellowish brown. **Stipules** linear or lanceolate, up to 1.2 cm long, *caducous*. **Leaves** *spirally arranged*, thin-coriaceous, *glabrous*, rough to the touch; ovate to elliptic or oblong, 8.5–18 × 2.5–8 cm, *base symmetric and cuneate*, *or asymmetric and with tiny auricle on one side*, *margin faintly lobed or toothed or entire and plane*, *apex caudate*, *acumen 1–4.5 cm long*; *midrib flat or rarely raised above*, *sharply keeled below*; *lateral veins 5–7 pairs*, *well-spaced*, *curved*, with short veins in between, raised below, faint or rarely sunken above, *basal pair extending up to 1/3 the length of the blade*, *with a gland in the axils of one or both of the veins*; intercostal venation reticulate, faint on both surfaces; *petiole 0.3–1 cm long*. **Syconia** *paired or in clusters*, *axillary or borne on twigs behind the leaves or on stem*, ripening yellow to red, subglobose, 0.16–1 cm diameter, apex umbonate; *peduncle 0.3–2.5 cm long*; basal bracts 1–2, minute, *lateral bracts absent*; internal bristles absent or few, minute. **Tepals** 5–7, whitish, oblong, puberulous, slightly united at the base. **Achenes** oblong, *c.* 1.5 mm long, somewhat compressed, keeled at the apex.

Vernacular names. Sarawak—*andai* (Bidayuh), *kara* (Iban).

Distribution. Endemic to Borneo. Uncommon in Sabah and Sarawak. Not known in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp to upper montane forests, up to 2800 m altitude.

39. **Ficus minahassae** (Teijsm. & de Vries) Miq.

(of Minahasa in Sulawesi)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 231; King *l.c.* (1888) 108; Merrill, Bull. Bur. For. Philip. 1 (1903) 18; Corner *l.c.* (1965) 63. **Basionym:** *Bosscheria minahassae* Teijsm. & de Vriese, Nat. Tijds. Ned. Ind. 23 (1861) 212. **Type:** unknown. **Synonym:** *F. riedelii* (*non* Teijsm. *ex* Miq.) Haberlandt, Bot. Trop. (1893) 191.

Dioecious tree, up to 25 m tall, sometimes with stilt-roots. **Twigs** 0.4–0.6 cm thick, pubescent with spreading hairs 2–4 mm long. **Stipules** ovate or lanceolate, *2–5 cm long*, hairy, caducous or persistent on the new shoots. **Leaves** *spirally arranged*, coriaceous, *rough-hairy above*, *yellowish soft-hairy below*; ovate, (9–)13–30 × (5–)7–20 cm, *base rounded or cordate*, *margin entire*, *plane*, apex acute or acuminate, acumen up to 1.2 cm long; *midrib raised above*; lateral veins 7–11 pairs, *basal pairs 3–5*, *short*, *departing from the midrib at a broad angle*, *with a gland in each axil of the lower most veins below*; intercostal venation scalariform slightly raised below; petiole 3.5–10 cm long.

Syconia *borne in small globular clusters along unbranched leafless twigs hanging from the trunk and main branches*, glabrous or finely hairy, ripening red, *obconical*, *0.5–0.6 cm diameter*; *peduncle 0.15–0.2 cm long*; basal bracts 3, ovate, *c.* 1.5 mm long, persistent; internal bristles abundant, white. **Tepals** 3–4, spathulate, pinkish or pale reddish, glabrous, free. **Achenes** *c.* 0.7 mm long, compressed, smooth, slightly keeled.

Vernacular name. Sabah—*tapian diwit* (Dusun).

Distribution. Borneo, the Philippines and Sulawesi (Minahasa). There is only one record of this species from Borneo, *Agama 9464*, from Timbun Mata Forest Reserve, Semporna district, in Sabah.

Uses. Figs edible; bark used for making various utensils in the Philippines and Sulawesi.

40. **Ficus moderata** Corner

(Latin, *moderatus* = moderate; bridging the subser. *Congestae* and subser. *Hispidae* of the ser. *Tuberculifasciculatae*)

Gard. Bull. Sing. 19 (1962) 396, *l.c.* (1965) 89; Whitmore, Tantra & Sutisna *l.c.* 250. **Type:** *RSNB 2592*, Borneo, Sabah, Mt. Kinabalu (holotype K).

Dioecious tree, up to 10 m tall. **Bark** grey, smooth. **Twigs** *c.* 0.4 cm thick, *solid*, *zig-zag*, brown, with ring-like stipular scars, hairy. **Stipules** lanceolate, *c. 1.5 cm long*, glabrous or hairy at the base, caducous. **Leaves** *spirally arranged*, sometimes opposite, thin-coriaceous, *hairy below*; elliptic to obovate, 8–21 × 5–11 cm, base broadly cuneate to narrowly subcordate, *margin entire or faintly lobed towards apex*, *apex acuminate*, *acumen 1.5 cm long*; *midrib raised above*; lateral veins 6–9 pairs, with shorter veins in between, finely raised below, basal veins short or extending up to 1/3 the length of the blade, *without axillary glands*; intercostal venation scalariform, distinct below; petiole 0.9–2.5 cm long, powdery hairy. **Syconia** *clustered on short branched compact woody processes arising from stem and branches*, *pear-shaped*, 1.5–2.3 cm diameter, surface rough with incurved short lateral bracts; *peduncle 0.4–1.4 cm long*; basal bracts ovate, 2–3 cm long, persistent; internal bristles absent. **Perianth** saccate or collar-like. **Achenes** *c.* 1 mm long, keeled, obscurely tuberculate.

Distribution. Endemic to Borneo. Very rare, known only by 2 collections from Mt. Kinabalu, Sabah.

Ecology. In hill mixed dipterocarp and lower montane forests, up to 1200 m altitude.

41. **Ficus montana** Burm. *f.*

(Latin, *montanus* = pertaining to mountains; the habitat)

Fl. Ind. (1768) 226; Backer & Bakhuizen *f. l.c.* 27; Corner *l.c.* (1965) 64; Whitmore, Tantra & Sutisna *l.c.* 250. **Type:** unknown. **Synonyms:** *F. humilis* Roxb., Fl. Ind., ed. Carey, 3 (1832) 535; *F. quercifolia* Roxb. *l.c.* 534; *F. inconstans* Miq. *l.c.* (1848) 232; *F. sclerocoma* Miq. *l.c.* (1851) 58; *F. ampelas* Burm. *f.* var. *bogoriensis* (Koord. & Valeton) Hochr., Candollea 2 (1925) 328.

Dioecious shrub. Young parts rough-hairy. **Twigs** reddish brown, *c.* 0.3 cm thick, *hollow*. **Stipules** paired, linear or lanceolate, *c.* 0.8 cm long, rough-hairy, caducous. **Leaves** *spirally arranged*, coriaceous, *rough-hairy below*, sparsely hairy above; elliptic, 6–10 × 2–5 cm, *base cuneate*, *margin irregularly lobed*, apex acuminate, acumen up to 1.5 cm long; *midrib raised above*; lateral veins 5–7 pairs, distinct below, faint above, basal veins short, *without axillary glands*; intercostal venation reticulate, distinct below, invisible above; petiole 0.5–1 cm long, *rough-hairy*. **Syconia** *solitary or in pairs*, *axillary*, *rough-hairy*, ripening red, ovoid to subglobose, *c. 0.5 × 0.3 cm*, apex umbonate to flat; *peduncle up to 0.3 cm long*; basal bracts 2–3, minute; internal bristles absent. **Tepals** 3–5, white, free, glabrous. **Achenes** 1–1.3 mm long, slightly compressed, minutely tuberculate, hardly keeled.

Distribution. India, Burma, Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. Very rare in Sabah and Sarawak; known by 2 collections, *SAN A 1053* and *SAN 117896*, from Sabah, and by *S. 36002*, *S. 40985*, and *S. 44751* from Kapit district in Sarawak. Not known in Brunei and Kalimantan.

Ecology. In lowland to lower montane forests, usually by streams.

Uses. Young leaves are eaten as salad; mature leaves are used in opium smoking in the past; the fruits edible.

42. **Ficus nota** (Blanco) Merr.

(Latin, *notus* = distinguishing mark; inference unknown)

Philip. Gov. Lab. Bur. Bull. 17 (1904) 10; Corner *l.c.* (1965) 88; Whitmore, Tantra & Sutisna *l.c.* 250. **Basionym:** *F. aspera* G. Forst. var. *nota* Blanco., Fl. Filip. (1837) 677. **Type:** *Merrill Spec. Blanc. No. 550*, the Philippines, Luzon, Rizal Province, Antipolo (*n.v*).

Dioecious tree, up to 13 m tall, often shortly buttressed. **Bark** brown, smooth. **Twigs** *solid*, 0.3–0.6 cm thick, brown, with large petiolar scars. **Stipules** appressed hairy, lanceolate, *c.* 1.5 cm long, caducous. **Leaves** *spirally arranged*, coriaceous, *sparsely hairy below*; obovate, 15.5–23 × 9–17 cm, *base broadly cuneate*, *margin entire*, *plane*, *apex obtuse*; *midrib raised above*; lateral veins 6–7 pairs, raised on both surfaces, basal veins 3–4 pairs, reaching up to 1/2 the length of the blade, *often with axillary glands below*; intercostal venation scalariform, visible on both surfaces; petiole 1–3.5 cm long, hairy. **Syconia** *borne on finger-like leafless processes arising from stem*, ripening brown, *pear-shaped*, 1.7–4.5 cm diameter, apex truncate with many bracts, surface rugose; *peduncle c. 0.5 cm long*; basal bracts 3, 1–2 mm long; internal bristles few, white. **Perianth** cup-shaped or collar-like. **Achenes** *c.* 1 mm long, smooth, keeled.

Distribution. Borneo and the Philippines. Very rare in Borneo, known only from Beaufort district in Sabah.

Ecology. In lowland mixed dipterocarp forest.

43. **Ficus obpyramidata** King

(Latin, *ob-* = inverted, *pyramidatus* = pyramid-shaped; the shape of the syconia)

Ann. Roy. Bot. Gard. Cal. 1, 2 (1888) 116; Ridley *l.c.* (1924) 343; Burkill *l.c.* 1028; Corner *l.c.* (1965) 88, *l.c.* (1988) 551; Kochummen *l.c.* 152; Anderson *l.c.* 259; Primack *l.c.* 94; Whitmore, Tantra & Sutisna *l.c.* 250; Turner *l.c.* 352. **Type:** *Kunstler 1849*, Peninsular Malaysia, Perak (K?).

Dioecious tree, up to 10 m tall, 20 cm diameter. **Bark** greyish brown. **Twigs** 0.3–0.6 cm thick, *hollow*, sparsely hairy with stiff dark brown hairs or glabrous. **Stipules** lanceolate, *2–2.8 cm long*, dark brown hairy, caducous. **Leaves** *spirally arranged*, membranous, *sparsely dark brown hairy below*; elliptic to obovate, 14–20 × 4.5–8.5 cm, *base cuneate*, *symmetric*, *margin entire or faintly toothed*, apex acute; *midrib flat above*; *lateral veins* 5–8 pairs, with shorter veins in between, *raised on both surfaces*, basal veins 2–3 pairs, reaching up to 1/4–1/3 the length of the blade; intercostal venation reticulate, visible below, faint above; *petiole 1.5–5 cm long*, hairy, glabrescent, *with a subnodal gland*. **Syconia** *borne on long finger-like projections arising from branches and stem*, ripening yellow to brownish ochre, *obpyramidal* or subconical with depressed apex, 2–2.5 cm diameter, *glabrous*, *with faint irregular lines and tiny projections*; *peduncle 1–3.6 cm long*; basal bracts 3, tiny, persistent, recurved; internal bristles few to abundant, whitish. **Perianth** tubular, covering 1/3 to the whole ovary or stamen. **Achenes** ovoid, *c.* 1 mm long, rather rough, slightly keeled.

Vernacular name. Sarawak—*engkunoh* (Iban).

Distribution. Burma, Thailand, Peninsular Malaysia, and Borneo. Rare in Sabah and Sarawak, known by *SAN 91021* from Ranau district in Sabah, and by *S. 18271* and *S. 39842* from Belaga district, and *S. 22036* from Kp. Segan in Bintulu district, Sarawak. Not known in Brunei and Kalimantan.

Ecology. In lowland forest by streams.

44. **Ficus obscura** Blume

(Latin, *obscurus* = indistinct; inference unknown)

Bijdr. Fl. Ned. Ind. (1825) 474; Miquel *l.c.* (1859) 302; King *l.c.* (1888) 87; Merrill *l.c.* (1921) 225; Corner *l.c.* 17 (1960) 480, *l.c.* (1965) 78; Kochummen *l.c.* 152; Anderson *l.c.* 259; Primack *l.c.* 95; Whitmore, Tantra & Sutisna *l.c.* 250; Turner *l.c.* 352; Coode *et al.* (eds.) *l.c.* 216. **Type:** *Blume s.n.* (= *RHL Sheet No. 908188590*), Java (L). **Synonyms:** *F. grewiaefolia* Blume *l.c.* 473; *F. scaberrima* Blume *l.c.* 474; *F. pisifera* Wall. *ex* Voight, Hort. Suburb. Calc. (1845) 285; *F. acuminatissima* Miq. *l.c.* (1848) 233; *F. dasycaula* Miq. *l.c.* (1848) 233; *F. lobbii* Miq. *l.c.* (1848) 233; *F. remblas* Miq. *l.c.* (1851) 60; *F. tajam* Miq. *l.c.* (1851) 62; *F. microtus* Miq. *l.c.* (1861) 428; *F. subdenticulata* (Miq.) Miq. *l.c.* (1867) 296; *F. grewiaefolia* Blume var. *angustata* Miq. *l.c.* (1867) 273; *F. microtus* Miq. var. *borneensis* Miq. *l.c.* (1867) 273; *F. scaberrima* Blume var. *angustata* Miq. *l.c.* (1859) 309; *F. celebica* Blume var. *kunstleri* King, *l.c.*(1887) 12; *F. obscura* Blume var. *scaberrima* (Blume) Miq. *l.c.* (1867) 273, *syn. nov.*; *F. viridifolia* Merr., Philip. J. Sc. (1913) Bot. 366; *F. microsyce* Ridl., Kew Bull. (1926) 82; *F. obscura* Blume var. *angustata* (Miq.) Corner *l.c.* 17 (1960) 481, *syn. nov.*; *F. obscura* Blume var. *borneensis* (Miq.) Corner *l.c.* 17 (1960) 481, *syn. nov.*; *F. obscura* Blume var. *kunstleri* (King) Corner *l.c.* 17 (1960) 481, *syn. nov.*

Dioecious tree, up to 7 m tall, or epiphyte. **Twigs** *c.* 0.3 cm thick, *terete*, grooved, *rough or woolly hairy*. **Stipules** lanceolate, *c.* 1.5 cm long, with long hairs along the margin, persistent. **Leaves** *distichous*, membranous to subcoriaceous, *almost sessile or with petiole up to 0.7 cm long*, *rough-hairy* to almost glabrous above, *brownish soft-hairy below*; oblong, elliptic, oblanceolate or subtrapeziform, 3.5–28 × 2.5–9.5 cm, *base strongly asymmetric*, *cuneate*, *margin distantly toothed*, lobed, or occasionally entire, *apex acuminate to caudate*, *acumen 3–6.5 cm long*; *midrib raised above*; lateral veins 5–7 pairs, raised below, faint above, basal pairs 2–3, short, *often with orange-brown glands in the axils below*; intercostal venation reticulate, visible below, faint above. **Syconia** *axillary or borne on twigs behind the leaves*, *in pairs or in fascicles of 3–8*, *sessile or with short peduncle*, sparsely to densely hairy, ripening greyish white to pink, yellow, orange and scarlet, subglobose, *0.5–1.2 cm diameter*, apex umbonate, ostiole with 5 peripheral bracts; basal bracts 2–3, minute; internal bristles absent or minute. **Tepals** 3–6, lanceolate, free or united at base to various degree, white, sometimes with pink spots. **Achenes** *c.* 1.5 × 0.8 mm, strongly keeled at the apex.

Vernacular names. Sarawak—*dunduk* (Bidayuh), *kara* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, and Sulawesi. Common and widely distributed in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland and hill forests, usually by streams, rarely on limestones.

Key to varieties

Twigs and leaves rough-hairy. Syconia sparsely hairy……………..........……….var. **obscura**
Twigs, leaves and syconia woolly soft-hairy........………………..……………………………

var. **lanata** Kochummen

(Latin, *lanatus* = clothed with woolly hairs; the petioles and leaf undersurface)

Gard. Bull. Sing. 50 (1998) 215. Type: *SAN 57361*, Borneo, Sabah, Semporna district (holotype KEP; isotype SAN).

Twigs reddish brown, woolly soft-hairy. Leaves woolly soft-hairy below, rough to the touch above. Syconia axillary or borne on twigs behind the leaves, in pairs or in clusters, sessile or peduncled, covered with woolly soft-hairs, subglobose, 0.8–1 cm diameter.

Endemic to Borneo. Frequent in Sabah; very rare in Sarawak, known by 1 collection *S. 28102* from Serian district. In lowland and hill mixed dipterocarp forests, often by streams, occasionally on limestones. Not known in Brunei and Kalimantan.

45. **Ficus oleifolia** King

(with leaves like that of olive tree—*Olea*, Oleaceae)

Ann. Roy. Bot. Gard. Calc. 1, 2 (1888) 160; Corner *l.c.* (1965) 38, Phil. Trans. Roy Soc. London Ser. B, 256 (1969) 313; Anderson *l.c.* 260; Primack *l.c.* 95; Whitmore, Tantra & Sutisna *l.c.* 251; Coode *et al.* (eds.) *l.c.* 216. **Type:** *Beccari PS 82*, Sumatra, Mt. Singalang (holotype FI; isotype L). **Synonym:** *F. oleifolia* King var. *major* King *l.c.* (1888) 160.

Dioecious shrub, up to 5 m tall. **Twigs** up to 0.2 cm thick, dark brown, irregularly swollen. **Stipules** linear to lanceolate, 0.3–0.8 cm long, glabrous. **Leaves** *spirally arranged*, *subcoriaceous*, *glabrous*, *sessile or with petiole up to 1(–1.3) cm long*; *elliptic*, *oblong*, *lanceolate*, *obovate*, *narrowly elliptic to linear*, *2.5–10.5 × 0.5–2.5 cm*, base attenuate to cuneate, *margin entire*, *revolute or plane*, *apex rounded*, *obtuse or acute-acuminate*; *midrib raised or sunken above*; *lateral veins* 5–20 pairs, *flat above*, joining near the leaf margin to form distinct intramarginal vein, basal veins 1 pair, short, *with a gland in each axil below*; intercostal venation equally prominent as lateral veins or invisible. **Syconia** *in pairs*, *axillary*, *sessile or with peduncle up to 2.5 cm long*, ripening dark purple, subglobose to ellipsoid, *0.2–0.8 cm diameter*, apex umbonate, sometimes basal part slightly tapered; basal bracts 3, persistent; internal bristles absent. **Tepals** 3 or 4, red, free. **Achenes** smooth or angled, kidney-shaped, *c.* 4 mm long.

Vernacular names. Sarawak—*ara* (Iban), *kayu tanyit*, *lunok*, *sulok kondat* (Kenyah).

Distribution. Sumatra, Borneo, the Philippines, and Sulawesi. Common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland to upper montane forests, up to 2400 m altitude, including riverbank and limestone habitats.

Key to varieties

(The epiphytic varieties are annotated under the main key: lead 170)

1. Leaf apex acute to acuminate……………………………………………………...2
   Leaf apex obtuse or rounded.......……………………………………………………5

2. Leaves linear or narrowly lanceolate, drying greenish, up to 1 cm wide………………..
   var. **linearifolia** Corner
   (Latin, *linearifolius* = linear-leaved)
   Phil. Trans. Roy. Soc. London Ser. B, 256 (1969) 313; Coode *et al*. (eds.) *l.c*. 216. Type: *Burt & Martin B 5497*, Borneo, Sarawak (holotype E).
   Small tree. Twigs blackish. *Leaves drying greenish*, *linear to narrowly lanceolate*, *2.5–11 × 0.6–1 cm*; base attenuate, often with 2 glands near petiole below, margin revolute, *apex acute to acuminate*, acumen 1 cm long; midrib raised above; lateral veins 7–10 pairs, very faint below, invisible above; petiole 0.2–0.9 cm long. Syconia ripening red, globose, 0.7–0.8 cm diameter, apex umbonate; peduncle 0.1–0.7 cm long; basal bracts tiny, persistent.
   Endemic to Borneo. Known in Sabah from Ranau and Kota Belud districts, and in Sarawak from Marudi district (Mt. Dulit and Mt. Murud) and Kapit district (Mt. Hose). In hill mixed dipterocarp to lower montane forests, at 1000–1800 m altitude.
   Leaves of different shapes, very much wider……………………....……………………...3

3. Lateral veins 13–15 pairs.......……………………………....…………………………
   var. **riparia** Corner
   (Latin, *riparius* = frequenting riverbanks)
   Gard. Bull. Sing. 17 (1960) 426, *l.c.* (1965) 38, *l.c.* (1969) 316; Coode *et al.* (eds.) *l.c*. 216. Type: *SFN 6871*, Borneo, Sarawak, Marudi district, Batang Baram (holotype SING).
   Small tree. *Leaves elliptic to lanceolate*, *3–12 × 0.5–4 cm*; base cuneate, margin

entire, plane, apex obtuse or acute; midrib raised above; *lateral veins 6–16 pairs*, visible below, invisible above; petiole 0.2–1.3 cm long. Syconia subglobose, 0.5–0.6 cm diameter; peduncle 1.5–2 cm long.

Endemic to Borneo. Common and widely distributed in Sarawak, not yet reported for Sabah. Also in Brunei. In lowland mixed dipterocarp forest to lower montane forest, up to 1800 m altitude.

Lateral veins 7–10 pairs, often indistinct.......…………………...………………………..4

4. Leaves drying greenish yellow; lateral veins indistinct. Confined to limestone forest…..

var. **calcicola** Kochummen

(Latin, *calcicolus* = inbabiting chalky soil)

Gard. Bull. Sing. 50 (1998) 215. Type: *Lee S. 38626*, Borneo, Sarawak, Bau district, G. Doya (holotype KEP; isotypes SAN, SAR).

Small tree. Twigs grey-brown. Stipules linear, *c.* 0.4 cm long. *Leaves drying greenish yellow*; *elliptic*, base cuneate, *margin revolute*, apex acute; midrib raised above; *lateral veins and intercostal venation very faint to inconspicuous*; petiole 0.7–1 cm long. Syconia axillary or borne on twigs behind the leaves, ellipsoid to subovoid, *c.* 0.3 cm diameter, apex umbonate; peduncle 0.3–0.4 cm long. Endemic to Borneo. Recorded only from Sarawak, locally frequent. In limestone forest.

Leaves drying brownish; lateral veins distinct. Not recorded from limestone forest.....…

var. **memecylifolia** Corner

(Latin, *memecylifolius* = with leaves resembling those of *Memecylon*, Melastomataceae)

Gard. Bull. Sing. 17 (1960) 425, *l.c.* (1965) 38; Whitmore, Tantra & Sutisna *l.c.* 251. Type: *Clemens 27939*, Borneo, Sabah, Mt. Kinabalu (holotype BM).

Small tree. *Leaves drying brownish*; *lanceolate to elliptic*, *2–8 × 0.7–2.7 cm*, base cuneate, margin entire, plane, apex acute; midrib raised above; *lateral veins 7–10 pairs*, *distinct below*, joining near the leaf margin to form distinct intramarginal vein; intercostal venation reticulate, faint below, invisible above; petiole up to 1 cm long. Syconia axillary, subglobose to ellipsoid, 0.3–0.6 cm diameter; peduncle 0.3–1.5 cm long.

Borneo and Sulawesi. Common in Sabah and Sarawak. In hill forest to upper montane forest, at 800–2000 m altitude.

5. Leaves obovate, apex rounded..…..………………………...…………………………...

var. **myrsinoides** Corner

(Greek, resembling *Myrsine*, Myrsinaceae; probably referring to the leaves)

Gard. Bull. Sing. 17 (1960) 425, *l.c.* (1965) 38; Whitmore, Tantra & Sutisna *l.c.* 251. Type: *SFN 27550*, Borneo, Sabah, Mt. Kinabalu (holotype SING).

Tree up to 13 m tall. *Leaves obovate*, 2.5–9 × 0.8–3 cm, base cuneate, margin entire, revolute, *apex rounded*; petiole 0.1–1 cm long. Syconia axillary or borne on twigs behind the leaves, ellipsoid or subglobose, 0.5–0.6 cm diameter; peduncle 0.15–0.8 cm long.

Endemic to Borneo. Very rare, reported only from Mt. Kinabalu in Sabah. In upper montane forest, up to 2100 m altitude.

Leaves elliptic or oblong, apex obtuse.......………………..……………………….…6

6. Lateral veins 9–20 pairs. Syconia with peduncle 1–1.5 cm long………...………………...

var. **valida** Corner
(Latin, *validus* = strong, robust-growing; the habit)
Phil. Trans. Roy Soc. London Ser. B, 256 (1969) 313; Coode *et al.* (eds.) *l.c.* 216. Type: *S. 19068*, Borneo, Sarawak (L).
Small tree. Leaves thick-coriaceous; *oblong* or lanceolate 4.5–13 × 1.5–4 cm, base attenuate, *margin distinctly revolute*, *apex usually obtuse*, rarely acute; basal glands distinct on the lower surface near petiole; midrib raised above; *lateral veins 9–20 pairs*, with thin and shorter veins in between, looping and joining near the leaf margin; intercostal venation invisible; petiole 0.3–1 cm long. *Syconia axillary*, subglobose, 0.7–0.8 cm diameter; *peduncle 1–1.5 cm long*; basal bracts persistent.
Endemic to Borneo; common in Sarawak, not yet reported for Sabah. Also in Brunei. In hill mixed dipterocarp to upper montane forests, at 800–2200 m altitude.

Lateral veins fewer than 9 pairs. Syconia with peduncle up to 0.6 cm long……………..
var. **oleifolia**
Sumatra and Borneo. In mossy lower to upper montane forests, at 1250–2400 m altitude.

46. **Ficus paramorpha** Corner

(Greek, *para-* = similar to, *-morphus* = -shaped; inference unknown)

Gard. Bull. Sing. 17 (1960) 440, *l.c.* (1965) 49; Whitmore, Tantra & Sutisna *l.c.* 251. **Type:** *Clemens 31777*, Borneo, Sabah, Mt. Kinabalu, Upper Kinataki R. (holotype L).

Dioecious small tree. **Twigs** *c.* 0.3 cm thick. **Stipules** *dark brown hairy*, *c.* 0.7 cm long. **Leaves** *spirally arranged*, somewhat chartaceous, *lower surface dark brown hairy*, upper surface scabrous; elliptic, 6–14 × 3–5.5 cm, *base symmetric*, *cuneate*, *margin toothed*, *apex acute*; *midrib raised above*; lateral veins 5–6 pairs, strongly raised below, basal pair reaching up to 1/3 the length of the blade, *with a gland in each axil below*; intercostal venation reticulate, raised below; petiole 1.2–2.5 cm long. **Syconia** *axillary*, *in pairs*, *sessile,* ripening red, *appressed dark brown hairy*, subglobose, *up to 1 cm diameter*; basal bracts ovate, up to 1.5 mm long; internal bristles numerous, golden yellow, up to 2.5 mm long. **Tepals** 3–4, white, hairy. **Achenes** shortly oblong, *c.* 1 mm long, somewhat rough, slightly keeled.

Distribution. Endemic to Borneo. Very rare, known by 2 collections only from Mt. Kinabalu in Sabah.

Ecology. In lower to upper montane forests, at 1600–2200 m altitude.

47. **Ficus pseudotarennifolia** Kochummen

(Greek, resembling but not equalling *F. tarennifolia*)

Gard. Bull. Sing. 50 (1998) 210. **Type:** *S. 51027*, Borneo, Sarawak, Marudi district, Bario (holotype KEP; isotypes SAN, SAR).

Dioecious tree, up to 6 m tall. **Twigs** *solid*, *c.* 0.3 cm thick, reddish brown, angled. **Stipules** lanceolate, acute, 1.5–1.7 cm long, caducous. **Leaves** *opposite*, thin-coriaceous, *glabrous*; narrowly oblanceolate, oblong or elliptic, 9.5–2.5 × 1–3.5 cm, *base cuneate*, *margin entire*, *revolute*, *apex acute*; *midrib raised above*; *lateral veins* 8–13 pairs, *often with glands in the axils below*, curving and joining near the leaf margin, visible below, very faint above; intercostal venation reticulate, visible below, almost invisible above; petiole 1–2.5 cm long. **Syconia** *borne on stem*, *in clusters*, pear-shaped, *c.* 2 × 1.2 cm, apex depressed; *peduncle to 1.2 cm long*; basal bracts tiny, persistent. **Perianth** whitish, cup-shaped, irregularly lobed.

Distribution. Endemic to Borneo. Rare, recorded only for Sarawak by 2 collections, *S. 11929* from Tatau district and the type.

Ecology. In lowland and hill mixed dipterocarp forests, up to 900 m altitude, by streams.

48. **Ficus pubinervis** Blume

(Latin, *pubi-* = softly hairy, *nervus* = vein; the soft-hairy midrib below)

Bijdr. Fl. Ned. Ind. (1825) 452; King *l.c.* (1887) 54; Merrill *l.c.* (1921) 226; Masamune *l.c.* 248; Backer & Bakhuizen *f. l.c.* 16; Corner (1965) *l.c.* 31; Whitmore, Tantra & Sutisna *l.c.*252. **Type:** *Blume s.n.* (= *RHL Sheet No. 908188457*), Java (holotype L). **Synonyms:** *F. decaisanei* Steud., Nom. Bot. ed. 2, 1 (1840) 636; *F. similis* Merr. Philip. J. Sc. 1 (1906) Suppl. 47; *F. crassitora* Elmer, Leafl. Philip. Bot. 2 (1908) 548.

Monoecious tree, up to 35 m; buttresses up to 2 m tall. **Bark** dark grey. Young parts pubescent. **Stipules** lanceolate, 2.5–3.5 cm long, *hairy outside*, caducous. **Leaves** *spirally arranged*, thin-coriaceous, *glabrous except for the hairy midrib below*; ovate, elliptic or lanceolate, 9.5–13.5 × 4–5 cm, base attenuate, *margin entire*, *plane*, apex acute or acuminate; *midrib raised on both surfaces*; lateral veins 5–7 pairs, looping and joining near the leaf margin, with shorter veins in between, distinct below, basal pair short, *mostly with a gland in each axil below*; intercostal venation reticulate; petiole 0.5–1.2 cm long, rough-hairy when young. **Syconia** *axillary*, *solitary or in pairs*, *sessile or short-peduncled*, ripening red, subglobose, *c.* 1.3 cm diameter, *hairy*, apex umbonate; basal bracts 3, ovate, acute, 1–1.5 mm long; internal bristles absent. **Tepals** 2–4, red, glabrous, free or basally united. **Achenes** *c.* 1 mm long, slightly keeled.

Distribution. Sumatra, Java, Borneo, Philippines, Sulawesi, Maluku, Sumbawa, and Flores. Very rare in Sabah, known by 1 collection, *SAN 28950*, from Mt. Kinabalu, not yet reported for Sarawak.

Ecology. In lower montane forest.

49. **Ficus racemosa** L.

(Latin, *racemosus* = in a raceme-like bunch; the syconia)

Sp. Pl. (1753) 922; Corner *l.c.* (1965) 34; Kochummen *l.c.* 154; Primack *l.c.* 98; Turner *l.c.* 353. **Type:** unknown. **Synonyms:** *F. glomerata* Roxb., Pl. Corom. 2 (1798) 13; *Covellia glomerata* (Roxb.) Miq. *l.c.* (1848) 465; *F. vesca* F.v.M. *ex* Miq. *l.c.* (1861) 243.

Distribution. Asia and Australia. Only var. *elongata* is present in Sabah and Sarawak.

var. **elongata** (King) Barrett
(Latin, *elongatus* = elongate; inference unknown)

Bull. Torr. Bot. Club 73 (1946) 323; Corner *l.c.* (1965) 35; Backer & Bakhuizen *f. l.c.* 27; Kochummen *l.c.* 154; Anderson *l.c.* 260; Whitmore, Tantra & Sutisna *l.c.* 252. **Basionym:** *F. glomerata* Roxb. var. *elongata* King *l.c.* (1888) 174. **Type:** *Kurz s.n.*, Burma, Chittagong (holotype CAL?). **Synonyms:** *F. lucescens* Blume *l.c.* 444; *F. lanceolata* Buch.-Ham. *ex* Roxb., Fl. Ind., ed. Carey, 3 (1832) 557; *Covellia lanceolata* (Buch.-Ham. *ex* Roxb.) Miq. *l.c.* (1848) 465; *Sycomorus riparia* Hochst. *ex* Miq. *l.c.* (1848) 114; *Urostigma lucescens* (Blume) Miq. *l.c.* (1859) 341; *F. riparia* (Hochst. *ex* Miq.) Miq. *l.c.* (1867) 295; *F. acidula* King *l.c.* (1888) 176; *F. henrici* King *l.c.* (1888) 176.

Monoecious tree, up to 18 m tall, 25 cm diameter. **Bark** greenish white, smooth; inner bark yellowish. **Sapwood** whitish. **Twigs** slender, reddish brown, *c.* 0.2 cm thick, **Stipules** narrowly lanceolate, up to 4 cm long, glabrous, often persistent. **Leaves** *distichous*, membranous, *glabrous*, *pale glaucous below*; oblong, 5–11 × 1.5–3.5 cm, base broadly cuneate, *margin entire*, *plane*, faintly undulate, *apex obtuse*; *midrib raised above*; *lateral veins 10–15 pairs*, *curved*, very faint on both surfaces, with shorter veins in between, basal pair short, *often with a gland in each axil below*; intercostal venation reticulate, faint; petiole slender, 1–4 cm long. **Syconia** *borne on long leafless branched twigs arising from stem and older branches*, ripening red, pear-shaped, 1–1.5 cm diameter, apex depressed; *peduncle 0.3–1.2 cm long*; basal bracts ovate, triangular, 1–2 mm long; internal bristles absent. **Tepals** 3–4, red, glabrous, united at the base. **Achenes** lenticular, *c.* 1 mm long, smooth, not or scarcely keeled.

Distribution. Abyssinia, India, Burma, Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, and Lesser Sunda Islands. Uncommon in Sabah and Sarawak, mainly reported for Sabah; from Sarawak known by a single collection, *S. 50082*, from Kapit district. Not known in Brunei. Also in Kalimantan.

Ecology. In lowland forest, in open area by streams.

50. **Ficus retusa** L.

(Latin, *retusus* = with rounded or notched end; the leaf apex)

Mant. (1767) 129; King *l.c.* (1887) 50; Merrill *l.c.* (1921) 226; Burkill *l.c.* 1030; Backer & Bakhuizen *f. l.c.* 35; Corner *l.c.* (1965) 20; Kochummen *l.c.* 154; Anderson *l.c.* 260; Primack *l.c.* 99; Whitmore, Tantra & Sutisna *l.c.* 253; Turner *l.c.* 353; Coode *et al.* (eds.) *l.c.* 217. **Type:** unknown.

Monoecious tree, up to 15 m tall. **Twigs** 0.3–0.6 cm thick, pale yellowish or grey-brown, distinctly grooved or with prominent stipular and petiolar scars (var. *borneensis*). **Stipules** small and caducous or large and persistent (var. *borneensis*), ovate to oblong, 1–3 × 0.5–1.5 cm. **Leaves** *spirally arranged*, *thin- to thick-coriaceous*, *glabrous*, sometimes slightly glaucous below; oblanceolate to narrowly obovate, 5–16 × 2.2–6 cm, base cuneate, *margin entire*, *plane* (*revolute* in var. *borneensis*), apex acute, obtuse or acuminate, acumen up to 1 cm long; *midrib sunken above*; *lateral veins* 5–8 pairs, *sunken above*, raised below, *curving and joining near the leaf margin to form distinct intramarginal vein*, basal pair reaching more than 1/2 the length of the blade, *without glands in the axils below*; intercostal venation reticulate, *sunken above*; petiole 0.8–2.5 cm long, grooved on the adaxial side. **Syconia** *in pairs*, *axillary*, *sessile*, ripening yellowish red, depressed globose, 0.5–0.6 cm diameter, apex umbonate; basal bracts ovate, 5–6 × 3–5 mm, or much smaller, persistent; internal bristles absent. **Tepals** 2–4, spathulate or lanceolate. **Achenes** tuberculate.

Vernacular name. Sarawak—*ara* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Java, and Borneo. Uncommon in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp forest.

Key to varieties

Leaves thin-coriaceous; stipules *c.* 1 × 0.5 cm, caducous. Basal bracts of syconia indistinct...var. **retusa**

Leaves thick-coriaceous; stipules *c.* 3 × 1.5 cm, persistent at the apex of twigs. Basal bracts conspicuous, covering the lower half of syconium...

var. **borneensis** Corner

(of Borneo)

Gard. Bull. Sing. 17 (1960) 393, *l.c.* (1965) 20; Whitmore, Tantra & Sutisna *l.c.* 253; Coode *et al.* (eds.) *l.c.* 217. Type: *Hallier 1074*, Borneo, Kalimantan, Sg. Sambas (holotype L).

Twig grey-brown, *c. 1 cm thick*, *with prominent stipular and petiolar scars*. *Stipules* ovate, acute, *c. 3 × 1.5 cm*, *persistent*. *Leaves thick-coriaceous*, pale glaucous below. Syconia with distinct basal bracts covering the lower half.

Endemic to Borneo. Rare in Sabah and Sarawak. Also in Brunei and Kalimantan. In lowland mixed dipterocarp forest.

51. **Ficus rubrocuspidata** Corner

(Latin, *rubrum* = red, *cuspidatus* = sharp and narrowly pointed; the leaf apex)

Gard. Bull. Sing. 17 (1960) 483, *l.c.* (1965) 79; Primack *l.c.* 100; Whitmore, Tantra & Sutisna *l.c.* 253; Coode *et al.* (eds.) *l.c.* 217. **Type:** *SFN 27323*, Borneo, Sabah, Mt. Kinabalu (holotype SING).

Dioecious small tree. **Twigs** *c.* 0.15 cm thick, brownish. **Stipules** linear to lanceolate, up to 0.8 cm long, caducous. **Leaves** *distichous*, membranous, *glabrous*, *drying greenish*; elliptic to obovate or narrowly oblong, 5–23 × 1.2–7 cm, *base symmetric*, *cuneate*, *margin entire*, *plane*, *apex cuspidate*, *acumen up to 4.5 cm long*; *midrib raised above*; *lateral veins 5–10 pairs*, *well-spaced*, *curved*, visible on both surfaces, looping and joining near the leaf margin, *basal pair short*, *inconspicuous*, departing from the midrib at a broad angle, *with a gland in the axil of one of the pair*; intercostal venation reticulate, visible on both surfaces; petiole 0.2–0.6 cm long. **Syconia** *paired or clustered*, *axillary or borne on twigs behind the leaves*, ripening orange to red, subglobose, *c. 0.4 cm diameter*, *sessile or short-peduncled*, without basal bracts; internal bristles absent. **Tepals** 4, red, free, glabrous. **Achenes** *c.* 0.8 mm long, scarcely keeled.

Vernacular name. Sarawak—*kara* (Iban).

Distribution. Endemic to Borneo. Common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp forest to lower montane forest, up to 1500 m altitude, along rocky streams and on limestones.

52. **Ficus rubromidotis** Corner

(meaning obscure)

Gard. Bull. Sing. 17 (1960) 484, *l.c.* (1965) 79; Anderson *l.c.* 260; Primack *l.c.* 100; Whitmore, Tantra & Sutisna *l.c.* 253. **Type:** *Clemens 20699*, Borneo, Sarawak, Bidi Cave Mountain (holotype K).

Dioecious small tree. **Twigs** *c.* 0.3 cm thick, yellowish, youngest angled. **Stipules** paired, broadly lanceolate, 1–2 cm long, rough-hairy, *persistent.* **Leaves** *distichous*, coriaceous, *glabrous*, drying yellowish green; oblong to elliptic, 15–36 × 5–12.5 cm, *base cuneate*, *shortly auriculate on one side*, *margin entire*, *plane*, *apex acuminate or caudate*, *acumen 1.2–5 cm long*; *midrib raised above*, *sharply keeled below*; *lateral veins 12–20 pairs*, *curved*, raised on both surfaces, looping and joining near the leaf margin, with few shorter veins in between, basal pair short, inconspicuous, *with a gland in the axil of one or both veins below*; intercostal venation scalariform, visible below, faint above; *petiole 0.3–1 cm long*. **Syconia** *axillary or in clusters on the stem and branches*, *sessile or peduncled*, ripening orange to red, subglobose, 0.5–0.7 cm diameter, apex umbonate; basal bracts 2–3, minute, *lateral bracts absent*; internal bristles absent. **Tepals** 4, red or red-brown, oblong, glabrous, free. **Achenes** oblong, *c.* 1 mm long, smooth, slightly keeled at apex.

Vernacular name. Sarawak—*kara* (Iban).

Distribution. Endemic to Borneo. Common in Sarawak; very rare in Sabah and known by a single collection, *SAN 90622*, from Ranau district. Not known in Brunei and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, including limestone forest, by streams.

53. **Ficus ruficaulis** Merr.

(Latin, *rufus* = reddish, *caulis* = stem or branch; with reddish branch)

Philip. Gov. Lab. Pub. 17 (1904) 13; Corner *l.c.* (1965) 47; Anderson *l.c.* 260; Primack *l.c.* 101; Whitmore, Tantra & Sutisna *l.c.* 253. **Type:** unknown. **Synonyms:** *F. gerontocarpa* Warb. *in* Perkin, Fragm. Fl. Philip. 3 (1905) 201; *F. paloensis* Elmer, Leafl. Philip. Bot. 2 (1908) 547; *F. zambalensis* Elmer, Leafl. Philip. Bot. 9 (1937) 3207; *F. ruficaulis* Merr. var. *paloensis* (Elmer) Elmer, Leafl. Philip. Bot. 1 (1906) 203.

Dioecious tree, up to 18 m tall. **Bark** greyish brown, smooth. **Twigs** stout, 0.5–1 cm thick, *reddish brown*, sparsely brownish rough-hairy. **Stipules** lanceolate, 1.2–2 cm long, *velvety brownish hairy*. **Leaves** *spirally arranged*, thin-coriaceous, *sparsely brownish rough-hairy on both surfaces*; ovate to oblong, *18–28 × 7–15.5 cm*, base cordate, rounded to cuneate, *margin entire*, *plane*, apex acuminate, acumen up to 1.5 cm long; *midrib raised above*; *lateral veins 6 pairs or more*, with shorter veins in between, raised on both surfaces, basal veins reaching more than 1/2 the length of the blade, *without axillary glands*; intercostal venation scalariform, visible below, faint above; petiole 3.5–6 cm long. **Syconia** *paired*, *axillary or borne on twigs behind the leaves*, ripening green or yellow, ovoid to subglobose, 0.7–0.8 cm diameter, apex umbonate; *peduncle 0.7–0.8 cm long*; basal bracts *c.* 3 × 2 mm, persistent; internal bristles abundant, yellowish, 1–1.5 mm long. **Tepals** 3–5, spathulate, free. **Achenes** *c.* 1.2 mm long, strongly keeled, tuberculate.

Vernacular name. Sarawak—*tempan* (Iban).

Distribution. Taiwan, Borneo, the Philippines, Sulawesi, and New Guinea. Very rare in Sabah and Sarawak, known by 1 collection from Sabah (*SAN 83127*) and two collections from Sarawak (*S. 19191* and *S. 37344*). Not known in Brunei and Kalimantan.

Ecology. In hill to lower montane forests, at 700–1200 m altitude.

54. **Ficus schwarzii** Koord.

(J.A.T. Schwarz, sometime teacher-missionary in Sulawesi)

Verl. Bot. Diens. Minahasa (1898) 607; Corner *l.c.* (1965) 89, *l.c.* (1988) 552; Kochummen *l.c.* 155; Anderson *l.c.* 260; Primack *l.c.* 103; Whitmore, Tantra & Sutisna *l.c.* 254; Coode *et al.* (eds.) *l.c.* 217. **Type:** *Koorders s.n.*, Sulawesi, Minahasa, G. Lengkoan (BO?, L?).

Dioecious tree, up to 20 m tall, 20 cm diameter. **Bark** dark grey, smooth. **Twigs** 0.15–0.25 cm thick, grey-brown, young ones angled. **Stipules** lanceolate, up to 1.5 cm long, caducous. **Leaves** *distichous*, membranous, *glabrous*; elliptic to oblanceoate, 8–20 × 2.5–6.5 cm, *base cuneate*, *symmetric*, *margin entire*, *plane*, *apex caudate*, *acumen up to 2.5 cm long*; *midrib flat above*; *lateral veins 5–9 pairs*, *well-spaced*, *curved*, raised below, faint above, *basal pair short*, *inconspicuous*, *without axillary glands*; intercostal venation scalariform to reticulate, visible on both surfaces; petiole 0.5–1 cm long. **Syconia** *borne in massive clusters on branched leafless twigs arising from the stem*, pear-shaped, *2.5–3.75 cm diameter*, ripening reddish brown, apex depressed with projecting scales; *peduncle 1–3 cm long*; basal bracts 3, 1–3 mm long; internal bristles absent or very few. **Tepals** united, tubular or collar-like. **Achenes** *c.* 1 mm long, keeled, faintly tuberculate.

Vernacular names. Sabah—*peranak* (Dusun). Sarawak—*ara*, *engkabuloh*, *engkeruroh, engkunoh* (Iban), *pipin* (Bidayuh).

Distribution. Burma, Thailand, Sumatra, Peninsular Malaysia, Borneo, and Sulawesi. Very common in Sarawak but rare in Sabah. Also in Brunei and Kalimantan.

Ecology. In lowland and hill forests by streams, up to 900 m altitude.

Use. In Sarawak, the latex is used in traditional medicine to treat ring-worms.

55. **Ficus scortechinii** King.

(Reverend Scortechini, 1845–1886, a Roman Catholic missionary; 1884–1886 government botanist stationed in Taiping, Perak)

Ann. Roy. Bot. Gard. Calc. 1, 2 (1888) 112; Ridley *l.c.* (1924) 343; Corner *l.c.* (1965) 94; Kochummen *l.c.* 156; Anderson *l.c.* 260; Turner *l.c.* 353. **Type:** *Kunstler 934*, Peninsular Malaysia, Perak (CAL, K?).

Distribution. Burma, Thailand, Peninsular Malaysia, Singapore, and Borneo. Only var. *lanceata* is recorded for Sabah and Sarawak.

var. **lanceata** Corner
(Latin, *lanceatus* = lance-shaped; the leaves)

Gard. Bull. Sing. 19 (1962) 401, *l.c.* (1965) 94; Primack *l.c.* 103; Whitmore, Tantra & Sutisna *l.c.* 254. **Type:** *RSNB 2815*, Borneo, Sabah, Mt. Kinabalu, Tenompok (holotype K).

Dioecious small tree, up to 6 m tall. **Twigs** *c.* 0.3 cm thick, solid, brown. **Leaves** *spirally arranged or opposite*, thin-coriaceous, *glabrous*; lanceolate, 6–20 × 1.6–4 cm, base cuneate, often slightly asymmetric, *margin faintly toothed*, *apex acute*, *acuminate or obtuse*; *midrib raised above*; lateral veins 6–10 pairs, basal pairs short; intercostal venation reticulate; *petiole* 0.5–1 cm long, *often with a small subnodal gland*. **Syconia** *borne in dense clusters on the stem*, *rarely on the main branches*, *or borne on twigs behind the leaves*, ripening red, obovoid, 0.7–1 cm diameter, *surface ridged and irregularly tuberculate*, *apex depressed*; *peduncle 1–2 cm long*; basal bracts 0.5–1 mm long, *lateral bracts absent*; internal bristles sparse, brownish. **Perianth** cup-shaped. **Achenes** up to 0.8 mm long, slightly keeled, tuberculate.

Vernacular name. Sarawak—*engkunoh* (Iban).

Distribution. Endemic to Borneo. Very rare, known only from Mt. Kinabalu in Sabah (the type), and by *S. 19388* from Sg. Anap, Tatau district, in Sarawak.

Ecology. In hill mixed dipterocarp forest to lower montane forest, up to 1500 m altitude.

56. **Ficus septica** Burm. *f.* Fig. 11.

(Greek, *septikos* = *putrefying*; the sap)

Fl. Ind. (I768) 226; Miq. *l.c.* (1859) 311; Merrill *l.c.* (1921) 226; Burkill *l.c.* 1032; Masamune *l.c.* 250; Backer & Bakhuizen *f. l.c.* 32; Corner *l.c.* (1965) 92; Primack *l.c.* 104; Whitmore, Tantra & Sutisna *l.c.* 254. **Type:** unknown. **Synonyms:** *F. leucopleura* Blume *l.c.* 443; *F. laccifera* Blanco, Fl. Philip. (1837) 684; *Covellia stictocarpa* Miq. *l.c.* (1851) 65; *F. stictocarpa* (Miq.) Miq. *l.c.* (1867) 284; *F. philippinensis* Bonard *ex* Herincq., Hort. France (1869) 244; *F. didymophylla* Warb. *in* Perkin, Fragm. Fl. Philip. 3 (1905) 200.

Dioecious tree, up to 25 m tall, 20 cm diameter. **Bark** pale grey. **Twigs** *hollow*, 0.2–0.4 cm thick, reddish brown. **Stipules** lanceolate, acute, 2–3 cm long, caducous. **Leaves** *spirally arranged*, *thin-coriaceous*, *glabrous*; *elliptic to oblong*, 10–28 × 3.7–11 cm, base

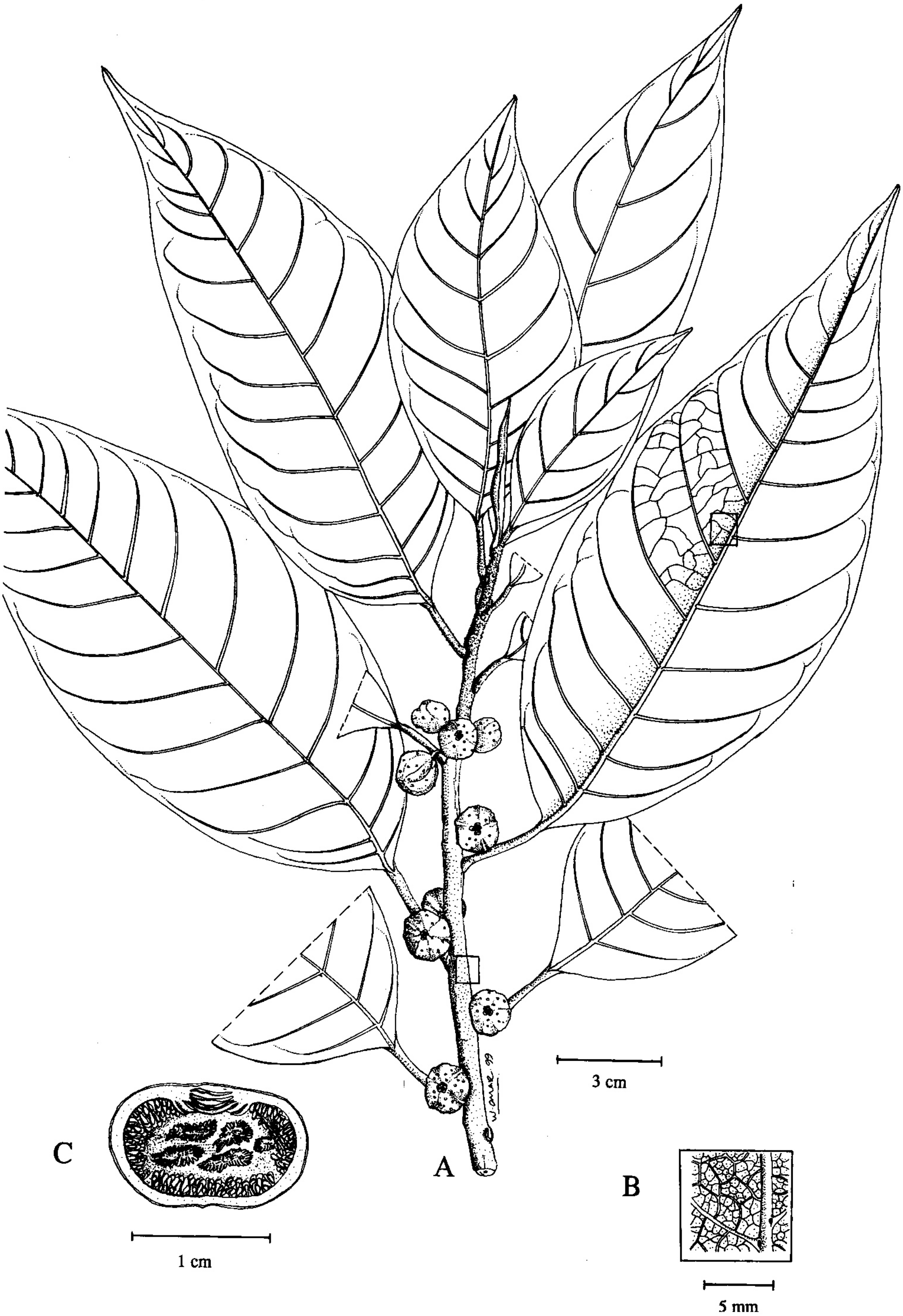

Fig. 11. *Ficus septica.* A, leafy twig with syconia; B, detail of lower leaf surface; C, longitudinal section of syconium. (From *Amin & Jarius SAN 116173.*)

broadly cuneate, *margin entire*, *plane*, *apex acute*; *midrib pinkish on drying*, *above often sunken on the lower half*, raised or flat on the upper half; *lateral veins* 8–12 pairs, *raised on both surfaces*, with few shorter veins in between, curving and joining near the leaf margin, *basal pairs inconspicuous*, *extending less than 1/3 the length of the leaf blade*, *without axillary glands*; intercostal venation finely reticulate, visible on both surfaces; *petiole 1–4.5 cm long*. **Syconia** *axillary or borne on twigs behind the leaves*, subhemispherical with depressed apex, 1.2–2 cm diameter, with pale dots and distinct ridges, ripening purplish; *peduncle up to 1.2 cm long*; basal bracts 3, subacute, 1–2 mm long; internal bristles short, few, white. **Tepals** 2–3, united. **Achenes** up to 1 mm long, slightly keeled, minutely tuberculate.

Vernacular name. Sarawak—*uok* (Kelabit).

Distribution. Ryu-Kyu, Taiwan, Sumatra, Java, Borneo, the Philippines, Sulawesi, Maluku, the Lesser Sunda Islands, New Guinea, Admiralty Islands, New Britain, New Ireland, Solomon Islands, New Hebrides, Santa Cruz Islands, and Queensland, Australia. Very common in Sabah, not yet reported for Sarawak. Not known in Brunei.

Ecology. In lowland forest to lower montane forest, up to 1200 m altitude.

57. **Ficus setiflora** Stapf

(Latin, *seta* = bristles, *florus* = flower; the abundant bristles in between the flowers)

FMK (1894) 226; Merrill *l.c.* (1921) 226; Masamune *l.c.* 250; Corner *l.c.* (1965) 50; Anderson *l.c.* 260; Primack *l.c.* 104; Whitmore, Tantra & Sutisna *l.c.* 254; Coode *et al.* (eds.) *l.c.* 217. **Type:** *Haviland 1214*, Borneo, Sabah, Mt. Kinabalu (K).

Dioecious shrub or small tree, up to 5 m tall. **Twigs** *c.* 0.2 cm thick, thinly appressed pale brown hairy. **Stipules** lanceolate, 0.3–0.9 cm long, densely fawn-sericeous, caducous. **Leaves** *spirally arranged*, membranous, *sparsely to densely appressed pale brown hairy on both surfaces*; elliptic, oblong or lanceolate, 5.5–19 × 2–6 cm, *base symmetric*, *cuneate*, *margin coarsely serrate*, *apex acuminate*, acumen up to 2 cm long; *midrib raised above*; lateral veins 4–7 pairs, with shorter veins in between, faintly raised above, raised below, basal pair reaching almost 1/2 the length of the blade, *with a gland in each axil below*; *intercostal venation reticulate*, visible below, faint above; petiole 0.5–2 cm long, hairy. **Syconia** *axillary*, *in pairs*, ripening rose-red, subglobose or oblong, *0.6–1 cm diameter*, *surface sparsely hairy*, apex umbonate; *peduncle up to 0.1 cm long*; basal bracts small, hairy, persistent, *lateral bracts absent*; internal bristles numerous, up to 2 mm long. **Tepals** 3–4, white, hairy. **Achenes** 1–1.2 mm long, slightly keeled, rough.

Distribution. Endemic to Borneo. Uncommon in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In hill mixed dipterocarp forest to upper montane forest, up to 2400 m altitude.

Key to varieties

1. Leaves sparsely hairy below...var. **setiflora**
   Leaves densely hairy below...2

2. Indumentum comprising hairs 0.5–1 mm long. Styles in female flowers hairy...............
 var. **adelpha** Corner
 (Greek, *adelphos* = joined together; probably referring to the stamens)
 Gard. Bull. Sing. 17 (1960) 440, *l.c.* (1965) 50; Whitmore, Tantra & Sutisna *l.c.* 254; Coode *et al.* (eds.) *l.c.* 217. Type: *SFN 27876*, Borneo, Sabah, Mt. Kinabalu (holotype SING).
 Uncommon in Sabah and Sarawak; in montane forest.

 Indumentum comprising hairs up to 0.5 mm long. Styles in female flowers glabrous.....
 var. **puberula** Corner
 (Latin, *peberulus* = downy with very short soft hairs; the twigs and petioles)
 Gard. Bull. Sing. 17 (1960) 441, *l.c.* (1965) 50; Whitmore, Tantra & Sutisna *l.c.* 254; Coode *et al.* (eds.) *l.c.* 217. Type: *Endert 4275*, Borneo, Kalimantan, W Kutai, Mt. Kemul (holotype L).
 Very rare, recorded only for Sarawak; in montane forest.

58. **Ficus sinuata** Thunb.

(Latin, *sinuatus* = with wavy margin; the leaves)

Diss. Fic. (1786) 12; Corner *l.c.* (1965) 76, *l.c.* (1988) 554; Backer & Bakhuizen *f. l.c.* 26; Anderson *l.c.* 260; Kochummen *l.c.* 156; Primack *l.c.* 105; Whitmore, Tantra & Sutisna *l.c.* 254; Turner *l.c.* 354. **Type:** *Thunberg s.n.*, Java (UPS). **Synonyms:** *F. raridens* Miq. *l.c.* (1848) 430; *F. obtusidens* Miq. *l.c.* (1851) 59; *F. angulidens* Miq. *l.c.* (1859) 310; *F. radicans* Roxb. var. *angulosa* Miq. *l.c.* (1859) 306.

Dioecious small tree, up to 6 m tall, with drooping branches. **Bark** yellowish. **Twigs** *c.* 0.2 cm thick, glabrous, yellowish. **Stipules** narrowly lanceolate, 0.5–0.7 cm long, caducous. **Leaves** *distichous*, thin-coriaceous, *glabrous*; *elliptic to oblong*, *9.5–23 × 3.5–9 cm*, *base often slightly asymmetric*, *cuneate*, *margin sinuate*, *slightly crenate*, *or deeply lobed*, apex caudate, acumen up to 2 cm long; *midrib raised above*, sharply keeled below; *lateral veins 5–8 pairs*, with shorter veins in between, curving and joining near the leaf margin, distinct below, faint above, basal pair extending up to 1/3 the length of the blade, *with a gland in each axil below*; intercostal venation reticulate, distinct below, visible above; petiole 0.3–2 cm long. **Syconia** *axillary*, *solitary or in pairs*, *or borne in clusters on the twigs behind the leaves*, ripening pinkish, orange to red, subglobose, *c.* 0.6–1 cm diameter, *base narrowed into a slender stalk*, without distinct peduncle; basal bracts 2–3, small; internal bristles absent. **Tepals** 2–5, shortly united at the base, glabrous, white or red-speckled. **Achenes** 1.5–2 mm long, compressed, smooth, strongly keeled at the apex.

Vernacular name. Sarawak—*terbudak* (Kelabit).

Distribution. Assam, Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. Very common in Sabah and Sarawak. Not known in Brunei.

Ecology. In hill forest.

59. **Ficus spathulifolia** Corner

(Latin, *spathulatus* = spathula-shaped, *folium* = leaf; with spathulate leaves)

Gard. Bull. Sing. 17 (1960) 391, *l.c.* (1965) 19; Kochummen *l.c.* 156; Anderson *l.c.* 261; Primack *l.c.* 105; Whitmore, Tantra & Sutisna *l.c.* 255; Coode *et al.* (eds.) *l.c.* 218. **Type:** *SFN 33970*, Peninsular Malaysia, Selangor, Klang (holotype SING). **Synonym:** *F. spathulifolia* Corner var. *stipitata* Corner *l.c.* 17 (1960) 392, *syn. nov.*

Monoecious tree, up to 13 m tall, 15 cm diameter. **Twigs** 0.3–0.5 cm thick, grey-brown, strongly ridged, with prominent stipular scars. **Stipules** hairy, oblong, acute, *c.* 1 cm long, caducous. **Leaves** *spirally arranged*, *coriaceous*, *glabrous*; *obovate to spathulate*, 3–8 × 1.3–4 cm, base cuneate, *margin entire*, *plane*, *apex rounded*; *midrib sunken above at the lower half*; *lateral veins* 3–5 pairs, raised below, *flat above*, looping and joining near the leaf margin, basal pair reaching up to 1/2 the length of the blade, *without axillary glands*; intercostal venation invisible or rarely faintly visible below; petiole 0.8–1.5 cm long, flat on the adaxial side. **Syconia** *in pairs*, *axillary*, *sessile*, ripening yellow to red, subglobose to subovoid, 0.6–0.7 cm diameter, apex umbonate; basal bracts up to 5 mm long, persistent; lateral bracts absent; internal bristles absent. **Tepals** 2–3, free. **Achenes** oblong, *c.* 1 mm long, slightly angled.

Vernacular name. Sarawak—*ara* (Iban).

Distribution. Indo-China, Peninsular Malaysia and Borneo. Widely distributed in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In Sabah and Sarawak mainly in peatswamp and *kerangas* forests.

60. **Ficus stolonifera** King

(Latin, *stolon* = underground runner, *ferus* = bearing; producing fig-bearing stolons)

Ann. Roy. Bot. Gard. Cal. 1, 2 (1888) 104; Merrill *l.c.* (1921) 226; Masamune *l.c.* 250; Corner *l.c.* (1965) 91; Anderson *l.c.* 261; Primack *l.c.* 106; Whitmore, Tantra & Sutisna *l.c.* 255; Coode *et al.* (eds.) *l.c.* 218. **Type:** *Beccari PB 2799*, Borneo, Sarawak (holotype FI).

Dioecious tree, up to 24 m tall, 30 cm diameter. **Twigs** up to 0.3 cm thick, yellowish brown hairy. **Stipules** narrowly lanceolate, *c.* 1.2 cm long, appressed hairy, *caducous*. **Leaves** *distichous*, *rarely opposite*, coriaceous, *rough-hairy on both surfaces*; elliptic to oblong, 8.5–27 × 4.5–9 cm, *base broadly cuneate*, *symmetric*, *margin denticulate to crenate*, apex acuminate, acumen 2–3 cm long; *midrib flat above*; lateral veins 4–7 pairs, with shorter veins in between, raised below, visible above, basal pair short; intercostal venation scalariform to reticulate, raised below, faint above; *petiole*, *0.3–0.6 cm long*, yellowish brown appressed hairy, *with a small subnodal gland*. **Syconia** *borne on stolons*, *subsessile*, finely appressed hairy, ripening reddish pink, subglobose, *c.* 0.7 cm diameter; *peduncle 0.1–0.3 cm long*; basal bracts 3, *lateral bracts few*; internal bristles absent. **Perianth** tubular or collar-like. **Achenes** *c.* 0.7 mm long, subcompressed, smooth, slightly keeled.

Vernacular name. Sarawak—*entimau* (Iban).

Distribution. Endemic to Borneo. Uncommon in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp forest to lower montane forest, up to 1200 m altitude.

61. **Ficus subfulva** Corner

(Latin, *sub-* = somewhat, *fulvus* = tawny; the indumentum on the twigs, petioles and veins of leaves beneath)

Gard. Bull. Sing. 17 (1960) 432, *l.c.* (1965) 47; Primack *l.c.* 108; Whitmore, Tantra & Sutisna *l.c.* 255. **Type:** *Hallier 2349*, Borneo, Kalimantan, G. Klam (holotype L).

Dioecious tree, up to 20 m tall. **Twigs** 0.4–0.6 cm thick, *yellowish brown hairy*. **Stipules** lanceolate, up to 1.5 cm long, *yellowish brown appressed hairy*, caducous. **Leaves** *spirally arranged*, rigid-coriaceous, *sparsely or densely yellowish brown velvety hairy on both surfaces*; elliptic, 10–25 × 5–11.5 cm, base rounded to subcordate, or cuneate, *margin entire*, *revolute*, apex subacuminate, acumen up to 1 cm long; *midrib flat above*; lateral veins 4–6 pairs, with a number of shorter veins in between, raised below, basal veins reaching up to 2/3 the length of the blade, *with a gland in each axil below*; intercostal venation reticulate, distinct beneath; petiole 1.2–5 cm long, hairy. **Syconia** *axillary*, *in pairs*, *thinly appressed yellowish brown hairy*, ripening orange-red, globose or ellipsoid, 1–1.2 cm diameter; *peduncle 0.4–1 cm long*; basal bracts ovate, acute, persistent, hairy, *lateral bracts absent*; internal bristles abundant, 2–4 mm long, stiff, yellow. **Tepals** glabrous, spathulate, red. **Achenes** *c.* 1.5 mm long, tuberculate.

Vernacular name. Sarawak—*tempan* (Iban).

Distribution. Endemic to Borneo. Very rare in Sabah and Sarawak. Also in Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, at 300–1000 m altitude, including limestone habitat.

Key to varieties

Leaf undersurface densely velvety hairy...

var. **villosula** Corner

(Latin, *villosulus* = finely shaggy hairy; the leaf under surface)

Gard. Bull. Sing. 17 (1960) 432, *l.c.* (1965) 475, Whitmore, Tantra & Sutisna *l.c.* 256. Type: *Hallier 2869*, Borneo, Kalimantan, Lianggagang (holotype L).

Endemic to Borneo. Very rare in Sarawak; in lowland mixed dipterocarp forest; not yet reported for Sabah. Also in Kalimantan.

Leaf undersurface sparsely velvety hairy..var. **subfulva**

62. **Ficus subterranea** Corner

(Latin, *subterraneus* = underground; the position of the syconia)

Gard. Bull. Sing. 18 (1960) 61, *l.c.* (1965) 92; Whitmore, Tantra & Sutisna *l.c.* 256; Coode *et al.* (eds.) *l.c.* 218. **Type:** *Corner BRUN 5327*, Borneo, Brunei, Amo, Sg. Belalong (holotype CGE; isotypes K, SAR).

Dioecious shrub or small tree, up to 5 m tall. **Twigs** up to 0.2 cm thick, appressed pubescent with whitish to pale yellowish brown hairs. **Stipules** 1.5–3 cm long, appressed hairy, caducous. **Leaves** *distichous*, membranous, upper surface glabrous, smooth or scabrous, *lower surface yellowish brown appressed hairy*; narrowly elliptic to obovate, 11–26 × 3–8 cm, *base cuneate*, *margin entire*, *plane*, *apex acuminate*, *acumen 1–2.5 cm long*; *midrib flat above*; lateral veins 11–15 pairs, with shorter veins in between, faint above, raised beneath, *distal ones with axillary glands*, *basal pair conspicuous*, *departing from the midrib at an acute angle*; intercostal venation finely scalariform, visible below, invisible above; petiole 0.5–1.5 cm long, appressed yellowish brown hairy. **Syconia** *borne on subterranean*, *branched*, *slender stolons arising from the base of stem*, glabrous, ripening pale pink, subglobose, *c.* 1.4 cm diameter; *peduncle 0.1–0.3 cm long*; *lateral bracts abundant*, uncinate, up to 0.6 mm long; internal bristles absent. **Perianth** absent. **Achenes** *c.* 0.6 mm long, slightly keeled, sparsely ridged.

Distribution. Endemic to Borneo. Very rare in Sabah and Sarawak. Also in Brunei.

Ecology. In lowland mixed dipterocarp forest.

63. **Ficus tarennifolia** Corner

(with leaves like that of *Tarenna*, Rubiaceae)

Gard. Bull. Sing. 18 (1960) 62, *l.c.* (1965) 93; Primack *l.c.* 111; Whitmore, Tantra & Sutisna *l.c.* 257.
Type: *SFN 27510*, Borneo, Sabah, Mt. Kinabalu (holotype SING).

Dioecious tree, up to 13 m tall. **Bark** brown, smooth, lenticellate; inner bark yellow-brown. **Sapwood** yellow-brown. **Twigs** slender, up to 0.3 cm thick. **Stipules** lanceolate, up to 2 cm long, caducous. **Leaves** usually *opposite*, sometimes *spirally arranged*, membranous, *glabrous*; lanceolate, elliptic or obovate, 7–21 × 2–8 cm, base cuneate, *margin distantly finely toothed*, *apex acute*; *midrib flat above*; lateral veins 5–18 pairs, curving and joining near the leaf margin, visible below, invisible above, basal pair inconspicuous, *without glands in the axils*; intercostal venation reticulate, visible below, invisible above; petiole 0.6–3 cm long, appressed hairy. **Syconia** *borne on short*, *leafless twigs arising from the stem*, *and also on long stolons arising from the base of stem,* reddish brown hairy, ripening to pinkish brown, pear-shaped to subglobose, 1.2–1.5 × 1–1.3 cm, *surface more or less smooth*, *apex rounded*; *peduncle 0.5–1.2 cm long*; basal bracts 3, up to 2 mm long, *lateral bracts absent*; internal bristles absent. **Perianth** tubular or collar-like. **Achenes** *c.* 1 mm long, slightly keeled, tuberculate.

Vernacular name. Sarawak—*buah tepur* (Kelabit).

Distribution. Endemic to Borneo; confined to Mt. Kinabalu in Sabah.

Ecology. In hill mixed dipterocarp forest to upper montane forest, at 1000–2500 m altitude.

64. **Ficus tinctoria** G. Forst.

(Latin, *tinctorius* = used in dying; the latex)

Prod. Fl. Ins. Austral. (1786)76; Corner *l.c.* 17 (1960) 475, *l.c.* 21 (1965) 74; Primack *l.c.* 112. **Type:** unknown.

Distribution. Andaman Islands, S China, Formosa, Indo-China, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Maluku, Lesser Sunda Islands, New Guinea, N Australia, Micronesia, and Polynesia. Only subsp. *gibbosa* is known in Sabah and Sarawak.

subsp. **gibbosa** (Blume) Corner
(Latin, *gibbosus* = more swollen in one place than another; the syconia)

Gard. Bull. Sing. 17 (1960) 476, *l.c.* (1965) 74, *l.c.* (1988) 544; Backer & Bakhuizen *f. l.c.* 25; Kochummen *l.c.* 159; Anderson *l.c.* 261; Primack *l.c.* 112; Whitmore, Tantra & Sutisna *l.c.* 257; Turner *l.c.* 355. **Basionym:** *F. gibbosa* Blume *l.c.* 466. **Type:** *Blume s.n.*, Java (L?) **Synonyms:** *F. cuneata* Blume *l.c.* 465; *F. paradoa* Blume, *l.c.* 467; *F. irregularis* Steud., Nom. Bot. ed. 2, 1 (1840) 636; *F. angulata* Miq. *l.c.* (1848) 434; *F. gibbosa* Blume var. *cuneata* (Blume) Miq. *l.c.* (1851) 62; *F. subobliqua* Miq. *l.c.* (1859) 225; *F. latiuscula* Miq. *l.c.* (1859) 225; *F. gibbosa* Blume var. *unigibba* Miq. *l.c.* (1867) 276; *F. gibbosa* Blume var. *dodonaefolia* Miq. *l.c.* (1867) 276; *F. latifolia* Miq. *l.c.* (1867) 276; *F. antoniana* Elmer, Leafl. Philip. Bot. 4 (1912) 1374.

Dioecious tree, up to 15 m tall, or *strangler*. **Twigs** up to 0.3 cm thick, pale yellowish. **Stipules** up to 1.8 cm long. **Leaves** *distichous*, coriaceous, *glabrous*, drying brown; elliptic, lanceolate, or rhomboid, 4–11 × 2.5–5 cm, *base cuneate*, *asymmetric*, *margin entire*, *plane or revolute*, *apex acute to acuminate*; *midrib raised above*; *lateral veins 4–5 pairs*, *well-spaced*, *curved*, looping and joining near the leaf margin, distinct below, faint above, with shorter veins in between, *basal pair inconspicuous*, *with a gland in the axil of the vein on the broader side of leaf base*; intercostal venation reticulate, visible below, faint to invisible above; *petiole 0.5–1 cm long*. **Syconia** *axillary*, *sessile or subsessile*, ripening golden yellow or red, *gibbous*, 0.7–1 cm diameter, surface faintly ridged, with apical pore; basal bracts 3, up to 2 mm long, caducous, lateral bracts absent; internal bristles numerous, minute. **Tepals** 3–5, oblong to lanceolate, white, puberulous, free. **Achenes** oblong, up to 1.3 mm long, subcompressed, not or only slightly keeled.

Distribution. Andaman Islands, S China, Indo-China, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines (Palawan), Sulawesi, Halmahera, Banda, and Sumbawa. Widely distributed in Sabah and Sarawak.

Ecology. In lowland forest and limestone forest.

Key to varieties

Syconia with peduncle 0.3–0.4 cm long. Leaf margin plane..........................var. **gibbosa**
Syconia sessile. Leaf margin revolute...

var. **rigida** (Miq.) Corner
(Latin, *rigidus* = rigid; the leaves)

Gard. Bull. Sing. 18 (1960) 476, *l.c.* (1965) 75. Basionym: *F. gibbosa* Blume var. *rigida* Miq. *l.c.* (1867) 276.

Sumatra, Borneo, Java, Sumbawa, and Alor. Rare in Borneo, known only by 2 collections each from Ranau district in Sabah (*SAN 119802*, *SAN 121454*), and from Belaga and Tatau (Ulu Mayeng) districts in Sarawak (*S. 19217*, *S. 39824*).

65. **Ficus treubii** King

(Melchior Treub, 1851–1910, former Director of the Bogor Botanic Gardens, Indonesia)

Ann. Roy. Bot. Gard. Calc. 1, 2 (1888) 105; Merrill *l.c.* (1921) 228; Corner *l.c.* (1965) 91; Anderson *l.c.* 261; Whitmore, Tantra & Sutisna *l.c.* 257; Coode *et al.* (eds.) *l.c.* 218. **Type:** *Beccari PB 2800*, Borneo, Sarawak (holotype FI).

Dioecious tree, up to 15 m tall, 20 cm diameter. **Bark** grey-brown. **Twigs** *solid*, *c.* 0.3 cm thick, sparsely hairy, with stipular scars. **Stipules** narrowly lanceolate, up to 1 cm long, hairy, caducous or subpersistent. **Leaves** *distichous*, membranous, drying greenish, *rough-hairy below*; elliptic to narrowly obovate, 13–23 × 4–9.5 cm, *base symmetric*, *cuneate*, *margin entire or crenate*, *slightly revolute*, *apex acuminate or caudate*, *acumen up to 3 cm long*; *midrib sunken above*; lateral veins 7–9 pairs, with shorter veins in between, *often with submarginal glands*, raised below, faint above; intercostal venation scalariform to reticulate, distinct below, almost invisible above; *petiole 0.7–1.2 cm long*, hairy. **Syconia** *borne on long racemose twigs arising from the stem or on stolons arising from the base of the stem*, *glabrous or thinly hairy*, ripening yellowish brown, obovoid, *c.* 1.5 cm diameter, surface pustulate, apex with a tiny ostiole; *peduncle up to 0.7 cm long*; basal bracts 3, in a collar, up to 2 mm long, lateral and apical bracts often present; internal bristles few to abundant, pale yellow to pale brown. **Perianth** cup-shaped or saccate. **Achenes** *c.* 0.8 mm long, slightly tuberculate.

Distribution. Endemic to Borneo. Common in Sabah, especially on Mt. Kinabalu, rare in Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp forest to lower montane forest, up to 1800 m altitude.

66. **Ficus uncinata** (King) Becc.

(Latin, *uncinatus* = hooked; the incurved lateral bracts on the syconium)

For. Born. (1902) 527; Merrill *l.c.* (1921) 228; Corner *l.c.* (1965) 91, *l.c.* (1988) 546; Kochummen *l.c.* 159; Anderson *l.c.* 261; Whitmore, Tantra & Sutisna *l.c.* 258. **Basionym:** *F. geocarpa* Teijsm. *ex* Miq. var. *uncinata* King *l.c.* (1888) 127. **Type:** *Beccari PB 2458*, Borneo, Sarawak (holotype FI). **Synonym:** *F. hypogea* (*non* King) Merr. *l.c.* (1921) 224.

Dioecious tree, up to 8 m tall, 15 cm diameter. **Twigs** *solid*, ridged, 0.3–0.6 cm thick, young ones covered with spreading or appressed hairs. **Stipules** lanceolate, acuminate, 3–4 cm long, hairy outside, *caducous or persistent*. **Leaves** *distichous*, drooping, coriaceous, thin-coriaceous or membranous, glabrous or *rough-hairy above*, *whitish or reddish brown soft-hairy below*; oblong, obovate, lanceolate or elliptic, 6–45 × 2–16 cm, *base prominently asymmetric*, *one side rounded or cordate or subcordate*, *and the other sharply cuneate or obliquely truncate*, very rarely symmetric, *margin finely dentate or entire and plane*, apex acuminate, acumen 2–7 cm long; *midrib raised or sunken above*; *lateral veins 6–13 pairs*, curved, with many shorter veins in between, raised below, faint above, basal veins 5–8 pairs on the broader side of leaf base, short; intercostal venation reticulate, scalariform, or subscalariform, distinct below, faint above; *petiole 0.5–2 cm long*, hairy, *with or without subnodal gland*. **Syconia** *borne on long runners arising from the base of stem*, ripening pink to dark red-brown or crimson, depressed globose, subglobose, oblong, or pear-shaped, 1.7–3.5 × 2–4 cm, *glabrous or hairy*, *with numerous incurved*, *lanceolate lateral bracts crowded round the sunken ostiole*; internal bristles absent. **Perianth** absent. **Achenes** *c.* 1.2 mm long, compressed, slightly keeled, with a ridge on each side.

Distribution. Sumatra, Peninsular Malaysia and Borneo. Widely distributed in Sabah and Sarawak.

Ecology. In lowland mixed dipterocarp forest to lower montane forest, up to 1200 m altitude, often by streams.

Key to varieties

1. Leaves whitish hairy on both surfaces...
var. **'C'**

Hairs whitish, *spreading*. *Twigs ridged*. *Stipules* ovate to lanceolate, *c.* 1.5 cm long, *persistent*. *Leaves* membranous, *whitish hairy on both surfaces*, drying greenish; oblong, 26–32 × 8.5–11 cm, base asymmetric, one side rounded, the other sharply cuneate, *margin distinctly toothed*, apex acuminate, acumen up to 3 cm long; midrib raised above; lateral veins 5–7 pairs, faintly raised on both surfaces; intercostal venation scalariform to reticulate; petiole 0.5–1 cm long, hairy. *Syconia* subglobose, *c.* 0.7 cm diameter (young), *hairy*.

Endemic to Borneo. Known only from Sarawak by 2 collections, *S. 34268* from Sabal Tapong FR in Samarahan district, and *S. 57178* from G. Putri in Lundu district.

Leaves reddish brown hairy..2

2. Syconia glabrous..3
Syconia hairy...4

3. Indumentum consisting of appressed hairs. Lateral veins 4–7 pairs..........................
....var. **uncinata** (in part)
Indumentum consisting of spreading hairs. Lateral veins 9–10 pairs..............................
var. **'A'**

Leaves thin-coriaceous, lower surface reddish brown hairy with spreading hairs; elliptic or oblong, 22–25 × 8–10 cm, base asymmetric, margin faintly toothed, apex acuminate, acumen *c.* 2 cm long; midrib flat above; *lateral veins 9–10 pairs*; intercostal venation scalariform; petiole *c.* 1 cm long, hairy. *Syconia glabrous*, 1.5–2 cm diameter.

Known by a single collection, *SAN 94520*, from Beluran, Labuk Sugut district, Sabah.

4. Stipules persistent...

var. **subbeccarii** Corner

(somewhat similar to *F. beccarii*)

Gard. Bull. Sing. 19 (1962) 401, *l.c.* 92; Whitmore, Tantra & Sutisna *l.c.* 258. Type: *RSNB 1619*, Borneo, Sabah, Mt. Kinabalu (holotype K).

Indumentum comprising appressed, *reddish brown hairs up to 1 mm long*. *Stipules persistent*, 1–2 cm long. Leaves coriaceous, appressed hairy on both surfaces; obovate, 10–30 × 4.5–10.5 cm, base symmetric or slightly asymmetric, margin entire, plane, apex acuminate, acumen *c.* 1.5 cm long; *lateral veins 4–7 pairs*; intercostal venation raised below. *Syconia* 1.4–2 cm diameter, *rough-hairy*.

Endemic to Borneo. Rare in Sabah and Sarawak.

Stipules caducous or subpersistent..5

5. Indumentum comprising hairs 2–4 mm long. Stipules subpersistent..............................

var. **pilosior** Corner

(Latin, *pilosiorus* = with thicker/longer hairs; the leaves)

Gard. Bull. Sing. 18 (1960) 59, *l.c.* (1965) 92; Whitmore, Tantra & Sutisna *l.c.* 258; Coode *et al.* (eds.) *l.c.* 219. Type: *BRUN 5302*, Borneo, Brunei, Sg. Belalong (holotype CGE).

Stipules lanceolate, up to 6 cm long, hairy, *subpersistent*. Leaves coriaceous, densely hairy below; elliptic to obovate, 20–45 × 7–16 cm, base cuneate on one side and cordate to auriculate on the other, margin faintly toothed, apex acuminate, acumen *c.* 2.5 cm long; lateral veins 10–13 pairs; petiole 0.7–1.5 cm long. *Syconia* subglobose, 2–2.5 cm diameter, *sparsely hairy*.

Endemic to Borneo. Known by a single collection, *S. 24304*, from Lambir Hill, Miri district, Sarawak. Also in Brunei and Kalimantan.

Indumentum comprising shorter hairs. Stipules caducous...6

6. Syconia densely hairy..7

Syconia sparsely hairy..8

7. Leaves 2.5–6 cm broad; hairs 0.5–1.5 mm long, appressed..

var. **gracilis** Corner

(Latin, *gracilis* = thin, slender; inference unclear)

Gard. Bull. Sing. 18 (1960) 58, *l.c.* (1965) 91; Whitmore, Tantra & Sutisna *l.c.* 258; Coode *et al.* (eds.) *l.c.* 219. Type: *BRUN 5303*, Borneo, Brunei (holotype CGE).

Indumentum as in var. *uncinata*. *Stipules caducous*. Leaves thin-coriaceous; *9–24 × 2.5–6 cm*, base asymmetric, margin faintly toothed, apex acuminate, acumen 1.5–2.5 cm long; midrib raised above; lateral veins 8–11 pairs; intercostal venation scalariform to reticulate; petiole 0.3–1 cm long, hairy. *Syconia* subglobose, 1.2–1.5 cm diameter, *villous.*

Endemic to Borneo. Not known in Sabah; in Sarawak recorded only by a few collections. Also in Brunei and Kalimantan.

Leaves 4–15 cm broad; hairs 1–2.5 mm long, erect...

var. **strigosa** Corner

(Latin, *strigosus* = covered with rigid, closely pressed, rather short, bristle-like hairs; the syconia)

Gard. Bull. Sing. 18 (1960) 59, *l.c.* (1965) 92; Kochummen *l.c.* 160; Whitmore, Tantra & Sutisna *l.c.* 258, Coode *et al.* (eds.) *l.c.* 219. Type: *SFN 25946*, Peninsular Malaysia, Johore (holotype SING).

Hairs 1–2.5 mm long, reddish, erect. *Stipules caducous*. *Leaves* thin-coriaceous, soft-hairy below, rough-hairy above; *12–16 × 4–6.5 cm*, base cordate on one side, cuneate on the other, margin faintly toothed, apex acuminate, acumen 1.2–2.4 cm long; midrib raised above; lateral veins *c.* 4 pairs; intercostal venation reticulate; petiole 0.5–0.8 cm long, hairy. *Syconia* oblong, *c.* 1.5 × 1 cm, *densely hairy*.

Sumatra, Peninsular Malaysia and Borneo. Not known in Sabah; very rare in Sarawak, known only by 1 collection, *S. 41983*, from Betong district. Also in Brunei and Kalimantan.

8. Leaves strongly asymmetric at the base, one side truncate, the other subcordate; lateral veins 9–11 pairs..9

Leaves not so; lateral veins 4–7 pairs..

var. **uncinata** (in part)

Hairs 0.5–1.5 mm long, reddish, appressed or spreading. *Stipules caducous*. *Leaves* coriaceous, *reddish brown soft-hairy below*, rough hairy above; ovate to lanceolate, 14–21.5 × 4–5.5 cm, base cuneate on one side, cordate on the other, margin faintly toothed, apex acuminate, acumen 3–7 cm long; midrib flat above; *lateral veins 4–7 pairs*; intercostal venation scalariform to reticulate; petiole 0.5–1 cm long, hairy. *Syconia* subglobose, 1.5–2.5 cm diameter, glabrous or *sparsely hairy*.

Common and widely distributed in Sarawak, not yet reported for Sabah.

9. Leaves 5–9 cm broad..

var. **truncata** Corner

(Latin, *truncatus* = truncate; the leaf base)

Gard. Bull. Sing. 18 (1960) 59, *l.c.* (1965) 92; Whitmore, Tantra & Sutisna *l.c.* 258; Coode *et al.* (eds.) *l.c.* 219. Type: *BRUN 5329*, Borneo, Brunei, Sg. Belalong (holotype CGE).

Hairs 0.5–1 mm long, appressed, reddish. *Stipules caducous*. Leaves coriaceous, appressed short-hairy on both surfaces; oblong, elliptic, or obovate, *16–29 × 5–9 cm*, *base asymmetric*, *one side obliquely truncate to cuneate the other subcordate or subauriculate*, margin entire, plane, apex acuminate, acumen 1.2–2 cm long; midrib flat above; *lateral veins 9–14 pairs*; intercostal venation scalariform to reticulate, raised below; petiole 0.6–1.1 cm long, appressed hairy. *Syconia sparsely hairy.*

Endemic to Borneo. Not known in Sabah; very rare in Sarawak, known by a single collection, *S. 34012*, from the Lanjak-Entimau Wildlife Sanctuary. Also in Brunei and Kalimantan.

Leaves 7–14 cm broad..

var. **'B'**

Hairs erect, brown, sparse. *Stipules caducous*, lanceolate, *c.* 2 cm long, hairy. *Leaves* coriaceous, sparsely hairy on both surfaces; oblong or elliptic, *15.5–31 × 7–14 cm*, *base strongly asymmetric*, rounded on one side, sharply cuneate on the other, margin faintly toothed, apex acuminate, acumen 1–2 cm long; midrib flat above; *lateral veins 8–11 pairs*, raised below, faint above; intercostal venation scalariform, *sunken above*, distinct below; petiole 0.8–1.5 cm long, hairy. *Syconia sparsely hairy*.

Endemic to Borneo. Known by 3 collections, *S. 40005* and *S. 66404* from Sarawak, and *Veldkamp 8379* from Bukit Raya, Kalimantan.

67. **Ficus variegata** Blume Fig. 12.

(Latin, *variegatus* = blotched; the leaves)

Bijdr. Fl. Ned. Ind. (1825) 459; Miquel *l.c.* (1859) 320; King *l.c.* (1888) 169; Merrill *l.c.* (1921) 228; Ridley, *l.c.* (1924) 335; Burkill *l.c.* 1032; Backer & Bakhuizen *f. l.c.* 28; Corner *l.c.* (1965) 82; Kochummen *l.c.* 160; Anderson *l.c.* 262; Whitmore, Tantra & Sutisna *l.c.* 259; Coode *et al.* (eds.) *l.c.* 219. **Type:** *Blume s.n.* (= *RHL Sheet No. 9081882067*, Java (L). **Synonyms:** *F. subracemosa* Blume *l.c.* 469; *F. cordifolia* Blume *l.c.* 438; *F. amboinensis* Kostel., Allg. Med. Pharm. Pl. 2 (1831) 408; *F. racemifera* Roxb., Fl. Ind., ed. Carey, 3 (1832) 560; *F. laevigata* Blanco, Fl. Filip. (1837) 682; *F. cerifera* Blume *ex* Bleekrode, Ann. Sc. Nat. IV, 3 (1855) 333; *F. subopaca* Miq. *l.c.* (1859) 320; *Urostigma javanicum* Miq. *l.c.* (1859) 334; *F. variegata* Blume var. *pilosior* Miq. *l.c.* (1867) 295; *F. latsoni* Elmer, Leafl. Philip. Bot. 1 (1906) 204; *F. polysyce* Ridl., J. Roy. As. Soc. Str. Br. 82 (1920) 195.

Dioecious tree, up to 40 m tall, 70 cm diameter, *without free hanging aerial roots*; buttresses up to 2 m high. **Bark** grey-brown, smooth. **Twigs** 0.2–0.4 cm thick, reddish brown. **Stipules** ovate, up to 0.6 cm long, silky hairy outside, caducous. **Leaves** *spirally arranged*, coriaceous, *glabrous*; *narrowly oblong*, *or ovate to lanceolate*, *9–20 × 4.5–12 cm*, *base symmetric*, *cuneate to rounded or subcordate*, *margin entire* (toothed in saplings), *plane*, *apex acuminate*, *acumen up to 1.5 cm long*; *midrib flat above*; *lateral veins 5–7 pairs*, with shorter veins in between, *well-spaced*, *curved*, *not steeply ascending*, raised on both surfaces, *basal pair conspicuous*, reaching more than 1/2 the length of the blade, often with a small gland in the axils; *intercostal venation scalariform*, distinct to faint on both surfaces; petiole 3–8 cm long. **Syconia** *borne in dense clusters on short twigs or tubercles arising from stem and branches*, ripening to rose-red, often streaked with white dots, *ellipsoid or pear-shaped*, 2–2.5 cm diameter, apex depressed; *peduncle 1–3 cm long*; basal bracts 3, persistent; internal bristles absent. **Tepals** 3–4, lanceolate or spathulate, free or shortly united at the base, glabrous, red to brownish. **Achene** 1–1.5 mm long, lenticular, slightly keeled, smooth.

Distribution. India, Burma, Indo-China, Andaman Islands, Malesia, Solomon Islands, and Queensland, Australia. Common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. Open areas in lowland forest.

Key to varieties

Leaves *c.* 12 × 5.5 cm; intercostal veins few, lax. Syconia ellipsoid or pyriform................
var. **ilangoides** (Elmer) Corner.
(meaning unclear)
Gard. Bull. Sing. 18 (1960) 33. Basionym: *Ficus ilangoides* Elmer, Leafl. Philip. Bot. 9 (1937) 3445. Type: unknown.
Borneo and the Philippines. In Borneo, very rare, known only from Kuala Penyu and Semporna (Palabag Is.) districts in Sabah.

Leaves larger; intercostal veins numerous, regular. Syconia ellipsoid..............var. **variegata**

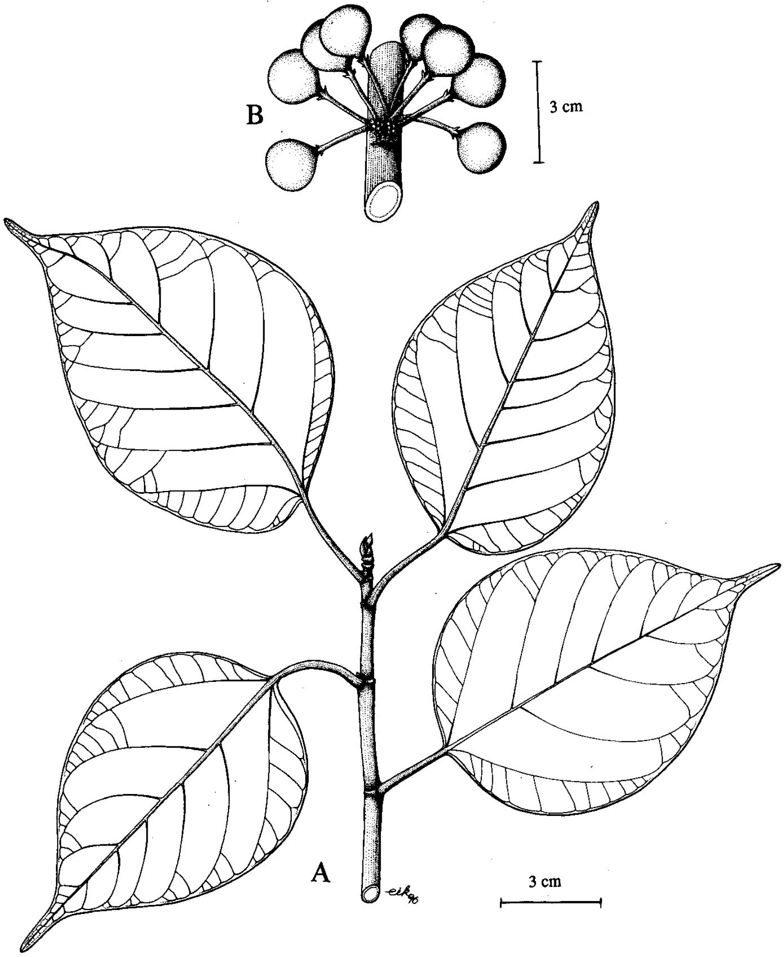

Fig. 12. *Ficus variegata*. A, leafy twig; B, a cluster of syconia. (From *Ashton S. 18366.*)

68. **Ficus virens** Ait.

(Latin, *virens* = green; the drying leaves)

Hort. Kew (1789) 451; Corner *l.c.* 17 (1959) 376. Type: unknown.

Distribution. India, Sri Lanka, Andaman Islands, Burma, S China, Hainan, Indo-China, Thailand, Malesia, Caroline Islands, Solomon Islands, and N Australia. Only var. *glabella* occurs in Sabah and Sarawak.

var. **glabella** (Blume) Corner
(Latin, *glabellus* = somewhat glabrous; the leaves)

Gard. Bull. Sing. 17 (1960) 377, *l.c.* (1965) 9; Backer & Bakhuizen *f. l.c.* 34; Kochummen *l.c.* 161; Anderson *l.c.* 262; Whitmore, Tantra & Sutisna *l.c.* 259. **Basionym:** *F. glabella* Blume *l.c.* 452. **Type:** *Blume s.n.*, Java (L?). **Synonym:** *Urostigma caulocarpum* Miq. *l.c.* (1848) 568; *F. caulocarpa* (Miq.) Miq. *l.c.* (1867) 265, *syn. nov.*

Monoecious small tree, *without or with a few to numerous tufted free hanging aerial roots*. **Twigs** pale reddish brown, 0.3–0.5 cm thick, irregularly grooved. **Stipules** ovate, up to 1.5 cm long, caducous. **Leaves** *spirally arranged*, thin-coriaceous, *glabrous*; *elliptic or obovate*, *5.5–14 × 2.5–6 cm*, *base symmetric*, *cuneate*, *margin entire*, *plane*, *apex acute or acuminate*, *acumen obtuse*, *c. 1.2 cm long*; *midrib raised above*, *keeled below*, *lateral veins 8–12 pairs*, with a number of shorter veins in between, *well-spaced*, *curved*, departing from the midrib at a broad angle, faint on both surfaces, curving and joining near the leaf margin, *basal pair conspicuous*; *intercostal venation scalariform*, faintly visible on both surfaces; *petiole 1.5–3.5 cm long*, channelled on the adaxial side. **Syconia** *axillary or borne on twigs behind the leaves*, *in pairs or in clusters*, ripening pink purple to black, *globose*, *0.4–0.7 cm* or *1–3 cm diameter*, *apex umbonate*, *sessile or peduncled*, *not covered by irritant hairs*; basal bracts broad, persistent, *lateral bracts absent*; internal bristles abundant, white. **Tepals** 2–4, ovate, spathulate or narrowly lanceolate, free or shortly united at the base. **Achenes** ovoid, smooth.

Distribution. Sri Lanka, Burma, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Maluku, and New Guinea. Rare in Sabah and Sarawak. Not known in Brunei.

Ecology. In lowland and hill forests, also in rocky coastal habitats.

69. **Ficus virescens** Corner

(Latin, *virescens* = becoming green; the drying leaves)

Gard. Bull. Sing. 19 (1962) 398, *l.c.* (1965) 91; Whitmore, Tantra & Sutisna *l.c.* 260; Coode *et al.* (eds.) *l.c.* 219. **Type:** *RSNB 965*, Borneo, Sabah, Mt. Kinabalu (holotype K).

Dioecious tree, up to 13 m tall. *Young twigs*, *petioles*, *stipules*, *and veins on the leaf undersurface appressed rough-hairy.* **Twigs** *solid*, 0.2–0.4 cm thick, yellowish, striate. **Stipules** lanceolate, up to 1.5 cm long, caducous. **Leaves** *spirally arranged or opposite*, thin-coriaceous, *sparsely hairy below*, *drying to pale greenish*; elliptic to narrowly obovate, 12–30 × 4–12 cm, *base symmetric*, *cuneate*, *margin faintly lobed*, apex acuminate to caudate, acumen 1.2–3 cm long; *midrib flat above*, slightly sunken towards lower half, sharply keeled below; *lateral veins* 5–7 pairs, with shorter veins in between, *flat above*, raised below, basal pair short or extending up to 1/4 the length of the blade; intercostal venation scalariform, raised below; *petiole 1–7 cm long*, *with a subnodal gland*. **Syconia** *borne in clusters on leafless branched twigs arising on the stem*, from ground-level up to about 3 m above the ground, ripening yellowish brown, brown short-hairy, subellipsoid, 1–1.5 × 0.7–1 cm, *surface with distinct ridges*, apex depressed with distinct ostiole; *peduncle 0.5–2.2 cm long*; basal bracts 3, in a collar, ovate, 2.5–4 mm long, glabrous; internal bristles many, yellowish, minute. **Perianth** collar-like or saccate. **Achenes** *c.* 1 mm long, tuberculate.

Distribution. Endemic to Borneo. In Sabah very rare, known by 2 collections only (*SAN 116842* from Sandakan district and the type). Also in Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp forest to lower montane forest, up to 1200 m altitude.

70. **Ficus xylophylla** Wall. *ex* Miq.

(Greek, *xylon* = wood; *phullon* = leaf; the thick cardboard-like leaves)

Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 286; King *l.c.* (1887) 29; Merrill *l.c.* (1921) 228; Ridley *l.c.* (1924) 332; Burkill *l.c.* 1033; Corner *l.c.* (1965) 16; Kochummen *l.c.* 162; Anderson *l.c.* 262; Whitmore, Tantra & Sutisna *l.c.* 260; Coode *et al.* (eds.) *l.c.* 219. **Type:** unknown.

Monoecious small to medium-sized *tree*, *or more frequently strangler*. **Bark** pale pinkish grey, smooth. **Twigs** stout, 1–1.2 cm thick, strongly ridged. **Stipules** ovate to lanceolate, *c.* 3.5 cm long, hairy outside, caducous. **Leaves** *spirally arranged*, *very thick-coriaceous*, *cardboard-like*, *glabrous*, drying yellowish brown above; usually obovate, 13.5–27 × 6.5–14 cm, base cuneate, *margin entire*, *revolute*, apex obtuse or rounded; *midrib sunken above*; lateral vein 4–7 pairs, looping and joining near the leaf margin, prominently raised below, *raised above except basal pair which is sunken*, basal pair extending up to 1/2 the length of the blade; intercostal venation reticulate, lax, visible below, invisible above; petiole 4–6 cm long, wrinkled when dry. **Syconia** *axillary*, *sessile*, *solitary or in pairs*, ripening orange and then purplish red, oblong, 3–4.5 × 2–2.8 cm, apex flat, surface rugose on drying; basal bracts persistent, 10–14 mm long, ovate, triangular, acute, keeled, concealed by the syconia; internal bristles absent. **Tepals** 2–4, lanceolate to subspathulate. **Achenes** tuberculate.

Distribution. Laos, Thailand, Sumatra, Peninsular Malaysia, and Borneo. Uncommon in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In lowland forest, including swamp forest.

Uses. The brightly coloured figs and the leaves are attractive enough to introduce this plant in landscaping.

4. **PARARTOCARPUS** Baill.

(resembling *Artocarpus*)

minggi or *pinggi* (Iban), *terap* (Malay)

Rusea Go

Adansonia 11 (1875) 294; Beccari, For. Born. (1902) 632; Merrill, EB (1921) 218; Masamune, EPB (1942) 251; Jarrett, J. Arn. Arb. 41 (1960) 320; Corner, Gard. Bull. Sing. 19 (1962) 241, *ibid*. 28 (1976) 183; Backer & Bakhuizen *f*., FJ 2 (1965) 17; Kochummen TFM 3 (1978) 162; Anderson, CLTS (1980) 262; Wong, DMT (1982) 8; Primack, Forester's Guide to the Moraceae of Sarawak (1983) 118; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 260; Rohwer *in* Kubitzki *et al.* (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 447; Coode *et al.* (eds.), CLBD (1996) 220; Argent *et al.* (eds.), MNDT-CK 2 (1997) 439, PROSEA 5, 3 (1998) 425. **Synonym:** *Gymnartocarpus* Boerl., Icon. Bog. 1 (1897) 73.

Medium-sized to large trees; buttresses sometimes present. **Bark** smooth or scaly, *covered with large pustular lenticels*; inner bark mottled with cream and orange patches; latex abundant, milky white. **Sapwood** pale yellow to brown. **Twigs** lenticellate or with prominent leaf scars. **Stipules** *non-amplexicaul*, caducous, scars intrapetiolar. **Leaves** *simple*, *spirally arranged*, thin- to thick-coriaceous, entire, glabrous or variously pubescent or scabrous. **Inflorescences** *unisexual*, rarely bisexual, *capitate*; *males and females indistinguishable externally before anthesis*, solitary or paired in leaf axils, peduncled; *basal involucre*, *if present*, *comprising 3–4(–8) deltoid or ovate persistent bracts*. *Male*, *female*, *or bisexual flowers sunken in numerous cavities over the entire surface of the receptacle*; receptacle armoured with closely set spine-like, conical, obtuse or truncate processes comprising perianth segments and interfloral bracts; at anthesis, anthers and stigma exserted between the processes. **Male flowers** *without well-developed perianth*, stamens 1–3 in each receptacle cavity, filaments free or united, *anthers extrorse*, rarely introrse, shortly exserted, pistillode absent. **Female** or **bisexual flowers** with solitary ovaries in each receptacle cavity; ovary unilocular, *style apical*, *with short exserted lanceolate or fimbriate stigmatic arms*; ovule subapical. **Syncarp** formed by the enlargement of the entire female inflorescence, of various sizes, subglobose to globose, covered with closely set spine-like connate processes. **Fruits** drupaceous, with firm exocarp. **Seeds** large, testa membranous with a thickened apical cap; embryo curved, cotyledons unequal, radicle large, straight; germination epigeal.

Distribution. Four species, distributed in Peninsular Thailand and Malesia (except Maluku and Lesser Sunda Islands). All four species occur in Sabah and Sarawak.

Ecology. In lowland to lower montane forests, up to 1800 m altitude.

Uses. Timber is traded as *terap*, a light hardwood. Seeds and latex are reported to be poisonous and the latter is used in the preparation of arrow poison.

Notes. The inflorescence is somewhat similar to that of *Artocarpus* but differs in having a usually well-developed involucre consisting of 3–4(–8) basal bracts. In *Artocarpus* the male and female inflorescences differ in shape, where as in *Parartocarpus* they are indistinguishable before floral anthesis. In *Parartocarpus* the anthers are extrorse or rarely introrse, while in *Artocarpus* they are consistently introrse. The bark of *Parartocarpus* trees is always covered with large lenticels.

Key to *Parartocarpus* species

(for sterile specimens)

1. Upper and lower leaf surfaces evenly scabrous; leaf margin conspicuously revolute..**3. P. spinulosus**
   Upper and lower leaf surfaces glabrous or sparsely or densely velvety hairy; leaf margin plane or only very slightly revolute..2

2. Leaves 1.6–4 cm wide; lateral veins forking to form irregular, rather jagged vein-loops near the leaf margin...**2. P. microcarpus**
   Leaves 3–10(–12) cm wide; lateral veins forming smooth vein-loops near the leaf margin..3

3. Lower leaf surface densely velvety hairy all over..........................**1. P. bracteatus**
   Lower leaf surface glabrous or at most with scattered hairs on the veins..**4. P. venenosus**

Key to *Parartocarpus* species

(for fertile specimens)

1. Inflorescences bisexual; lateral veins of leaf forking to form irregular, rather jagged vein-loops near the leaf margin...**2. P. microcarpus**
   Inflorescences unisexual; lateral veins of leaf forming smooth vein-loops near the leaf margin...2

2. Syncarp up to 3 cm diameter. Leaf surface evenly scabrous.................**3. P. spinulosus**
   Syncarp 10–18 cm diameter. Leaf surface glabrous or sparsely or densely velvety hairy below...3

3. Peduncle densely short patent-hairy; basal bracts 6–8 mm long. Syncarp processes spine-like, 3–5 × 2–3 mm. Lower leaf surface densely velvety hairy all over..**1. P. bracteatus**
   Peduncle sparsely appressed short-hairy; basal bracts 3–5 mm long. Syncarp processes truncate to flattened or spine-like, mostly 4–7 × 3–5 mm. Lower leaf surface glabrous or at most with scattered hairs on the veins...............................**4. P. venenosus**

1. **Parartocarpus bracteatus** (King *ex* Hook.) Becc.

(Latin, *bracteatus* = with bracts; the well-developed involucre of bracts at the base of the inflorescence and syncarp)

For. Born. (1902) 632; Jarrett, J. Arn. Arb. 40 (1959) 12, *l.c.* (1960) 324; Kochummen *l.c.* 164; Anderson *l.c.* 264; Primack *l.c.* 120; Whitmore, Tantra & Sutisna *l.c.* 260; Turner, Gard. Bull. Sing. 47 (1995) 356;

Argent *et al.* (eds.) *l.c.* 440. **Basionym:** *Artocarpus bracteata* King *in* Hooker *f.*, Fl. Brit. Ind. 5 (1888) 540, Ridley *l.c.* (1924) 352. **Lectotype** (Jarrett, 1960)**:** *Griffith 4663*, Peninsular Malaysia, Malacca (holotype CAL; isotype K).

Tree up to 50 m tall, 80 cm diameter; bole straight, with many branches, without buttresses. **Bark** whitish to brownish grey. **Sapwood** cream to pale white. **Twigs** brown, glabrous, with prominent petiolar scars. **Stipules** broadly lanceolate, 0.5–1 cm long, rufous pubescent. **Leaves** thick-coriaceous, glabrous above, *densely velvety rufous hairy below*; obovate to oblong, *(14–)16–20(–24) × (6–)8–10(–12) cm*, base obtuse to cuneate, *margin entire*, *plane or slightly revolute*, apex rounded to acute; midrib sunken above, raised below; *lateral veins* 10–12 pairs, sunken or flat above, prominent beneath, *forming smooth vein-loops near the leaf margin*; intercostal venation scalariform, raised below; petiole 2–4 cm long, pubescent. **Inflorescences** *unisexual*; *peduncle* 2–4 cm long, *densely patent short-hairy*; *basal bracts 3*, *6–8 mm long*. **Male heads** globose, 2.5–3.5 cm diameter, spinulous; stamens 2 in each cavity, up to 8 mm long, filaments free or united at the base, anthers oblong, apiculate, 2.5–3 mm long. **Female heads** spinulous as the males, most of the processes basally connate in groups of 2–4; styles lanceolate, up to 3 mm long, exserted in between the free apices of the processes. **Syncarps** subglobose, *up to 10 cm diameter*, shallowly lobed; *surface with fine spine-like processes 3–5 × 2–3 mm*, those on lobes bulbous at the base; *peduncle* 4–5 cm long, *densely short patent-hairy*; core *c.* 4 cm across. **Fruits** numerous, ellipsoid, *c.* 1.5 × 1.2 cm.

Vernacular names. Sabah—*terap* (Malay). Sarawak—*kaher* (Kayan), *kateh, minggi, pinggi* (Iban), *selangking* (Malay).

Distribution. Peninsular Malaysia, Sumatra and Borneo. Rare and uncommon in Sabah and Sarawak. Also in Kalimantan.

Ecology. In mixed dipterocarp forest on hillsides, on clayey soils, up to 500 m altitude. Flowering and fruiting from April–October.

2. **Parartocarpus microcarpus** Corner

(Greek, *mikros* = small, *karpos* = fruit; with small syncarps)

Gard. Bull. Sing. 28 (1976) 184; Primack *l.c.* 121; Whitmore, Tantra & Sutisna *l.c.* 260. **Type:** *S. 28676*, Borneo, Sarawak, Kapit district, Ulu Baleh, Bt. Tibang (holotype SAR; isotypes K, SAN).

Tree up to 30 m high, 45 cm diameter; buttresses up to 2 m tall. **Bark** whitish to grey; inner bark yellowish pink. **Twigs** 0.3–0.5 cm thick, greyish, sparsely covered by stiff whitish short hairs. **Stipules** 0.2–0.35 cm long, appressed hairy, caducous. **Leaves** thick-coriaceous, glabrous above, *sparsely velvety hairy below*; oblanceolate to elliptic, *3–10 × 1.6–4 cm*, base attenuate, acute, *margin entire*, *plane*, apex rounded with mucronate tip; midrib flat above, raised below; *lateral veins* 6–8 pairs, conspicuous and prominent on both surfaces, *forking to form irregular*, *rather jagged vein-loops near the leaf margin*; intercostal venation fine, somewhat reticulate, indistinct on both surfaces; petiole 1.5–3.5 cm long, sparsely covered with short white hairs. **Inflorescences** *bisexual*, globose, *c.* 1.75 cm across; peduncle 1–3 cm long; basal bracts 4, short-hairy, persistent. **Male**

flowers numerous, in hairy receptacle cavities 4–5 × 3–4 mm; tepals 2, minute; stamens 2, rarely 1 or 3, anthers 3–4 × 1.5 mm, *introrse*, not exserted, filaments very short, free, with conspicuous hairs around the base; pistillode absent. **Female/bisexual flowers** solitary in sparsely hairy receptacle cavities, few; tepals 2–3(–4); ovary glabrous, style terminal, embedded in the receptacle wall, exserted between the tepals, stigma short, simple, hardly projecting. **Syncarps** subglobose, 2.5–3 cm diameter, covered with flat, scarcely enlarged truncate processes. **Fruits** 1–1.5 × 1 cm, dark brown; exocarp thin, endocarp woody, *c.* 0.5 mm thick; seed-coat membranous.

Vernacular names. Sarawak—*kateh, kati* (Iban), *minggi* (Malay).

Distribution. Endemic to Borneo. Recorded only for Sabah and Sarawak, uncommon. In Sabah known from Tambunan district, and in Sarawak recorded for Miri and Limbang districts.

Ecology. In lower montane forest, at 1300–1800 m altitude. Flowering and fruiting from March–October.

3. **Parartocarpus spinulosus** R. Go Fig. 13.

(Latin, *spinulosus* = minutely spiny; the rough-hairy leaf surface)

Sandakania 12 (1998) 1. **Type:** *Soepadmo, Rena & Kalkausar FRI 41312*, Borneo, Sabah, Kinabatangan district, Telupid, Bt. Tawai FR (holotype KEP; isotypes K, L, SAN, SAR).

Tree up to 10 m, 15 cm diameter. **Bark** scaly to shallowly fissured, brown; inner bark yellow. **Sapwood** pale yellow. **Twigs** with prominent petiolar scars, sparsely appressed hairy when young, glabrescent. **Stipules** *c.* 0.15 × 0.1 cm, connate, caducous. **Leaves** thick-coriaceous, *evenly scabrous*; obovate, 8–14(–16) × (4–)5–7 cm, base cuneate with small auriculate extension, *margin entire*, *conspicuously revolute*, apex rounded to strongly emarginate; midrib and lateral veins flattish above, raised beneath; *lateral veins* 8–10 pairs, *forming smooth vein-loops near the leaf margin*, hairy on the veins below; petiole 2–3 cm long, strongly wrinkled, sparsely stiff-hairy when young, glabrescent. **Inflorescences** *unisexual*; males globose, 1–3 cm diameter; peduncle 2–4 cm long, glabrous; basal bracts 4, persistent. **Male flowers:** stamens two per receptacle cavity, anthers lanceolate, 0.5–1 mm long, exserted at anthesis. **Female flowers** not seen. **Syncarps** globose, *up to 3 cm diameter* (immature), with obtuse or truncate processes. **Fruits** numerous, embedded in the club-shaped receptacle.

Distribution. Endemic to Borneo. Rare, only known by 2 collections, the type and *Leopold SAN 43885* from Mile 87½, Telupid Road, Sandakan district, Sabah.

Ecology. In lowland mixed dipterocarp forest, up to 150 m altitude, on ultrabasic soils, along stony river banks.

Notes. Close to *Parartocarpus venenosus* subsp. *borneensis* but differs by its strongly scabrous leaf surface.

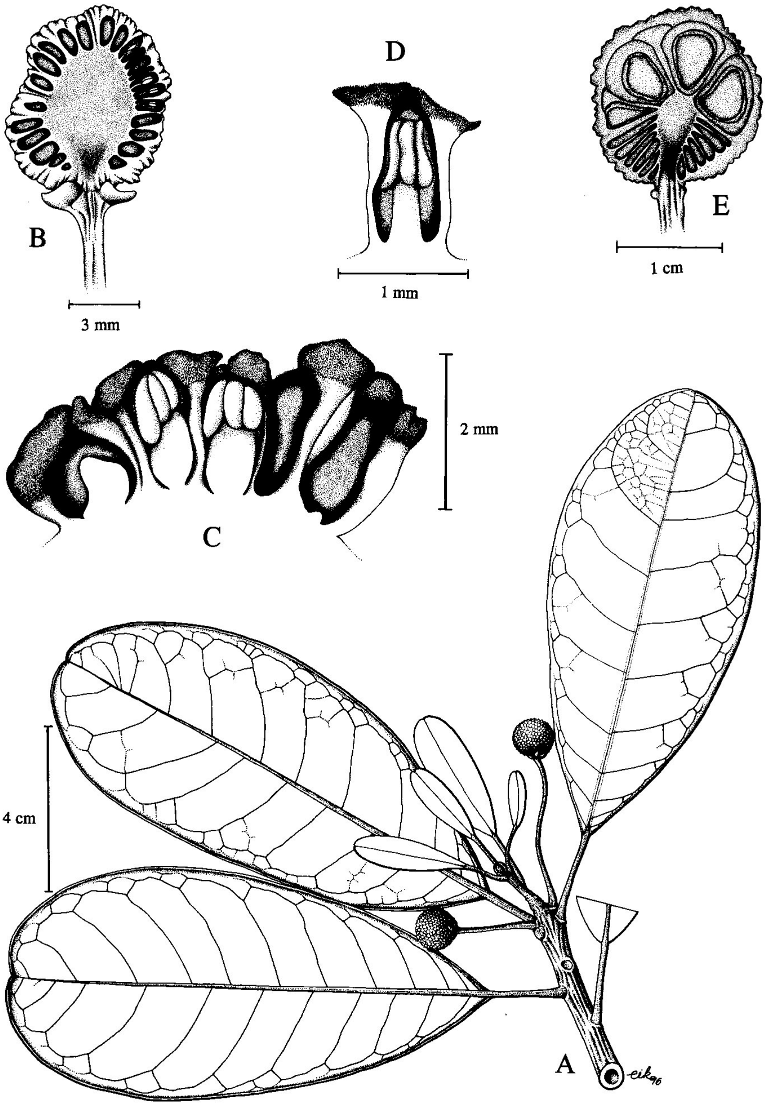

Fig. 13. *Parartocarpus spinulosus*. A, leafy twig with inflorescence heads; B, longitudinal section of male inflorescence; C, cluster of male flowers; D, male flower; E, longitudinal section of young syncarp. (From *Soepadmo, Rena & Kalkausar FRI 41312.*)

4. **Parartocarpus venenosus** (Zoll. & Moritzi) Becc. Fig. 14.

(Latin, *venenosus* = very poisonous; the latex)

For. Born. (1902) 632; Jarrett *l.c.* (1960) 326; Kochummen *l.c.* 165; Anderson *l.c.* 262; Primack *l.c.* 121; Whitmore, Tantra & Sutisna *l.c.* 260; Turner *l.c.* 356; Coode *et al.* (eds.) *l.c.* 220; Argent *et al.* (eds.) *l.c.* 440. **Basionym:** *Artocarpus venenosa* Zoll. & Moritzi, Nat. Gen. Arch. Neerl. Ind. 2 (1845) 213. **Type:** *Beccari PB 2557*, Borneo, Sarawak (K, P). **Synonyms:** *A. tylophylla* Miq., Fl. Ind. Bat. 1 (1859) 289; *A. cerifera* Miq., Ann. Mus. Lugd.-Bat. 3 (1867) 212; *A. riedelii* Miq. *l.c.* (1867) 213; *P. beccarianus* Baill., Adansonia 11 (1875) 294; *Gymnartocarpus venenosus* (Zoll. & Moritzi) Boerl., Handl. Fl. Ned. Ind. 3 (1900) 73; *A. woodii* Merr., Philip. J. Sc. 3 (1908) Bot. 221.

Tree up to 35 m tall, 50 cm diameter; buttresses up to 1.5 m high, or absent. **Bark** yellowish to greyish brown. **Twigs** greyish, rugose, appressed pubescent. **Leaves** thin- to thick-coriaceous, *glabrous or sparsely hairy on the veins beneath*, drying grey-green to purplish brown above, yellow-green to red-brown below; obovate, oblong, oblanceolate or elliptic, *4–23(–30) × 3–10 cm*, base rounded or cuneate, sometimes auriculate, *margin entire*, *plane to slightly revolute*, apex rounded, obtuse to short-acuminate; midrib prominent, flattish or sunken above, raised beneath; *lateral veins* 6–15 pairs, *forming smooth vein-loops near the leaf margin*; intercostal venation reticulate, obscure above; petiole 1.5–5 cm long. **Inflorescences** *unisexual*; males globose, 1.5–3 cm diameter, covered with closely set spine-like, conical, obtuse, umbonate or truncate processes; females similar to the males but the processes mostly connate at the base in groups of 2–4; peduncle 1.2–6 cm long, *sparsely appressed short-hairy*; bracts 3–4 (–8), deltoid, short-pubescent to glabrous, *3–5 mm long*. **Male flowers:** stamens 1–3 per receptacle cavity, filaments up to 4 mm long, united, anthers oblong, obtuse, 2–2.5 mm long. **Female flowers:** style lanceolate, fimbriate, exserted. **Syncarps** *up to 18 cm diameter*, subglobose, *covered with truncate to flat or spine-like processes 4–7 × 3–5 mm*; peduncle 3–10 cm long, *sparsely appressed short-hairy*. **Fruits** ellipsoid, with thick stony endocarp.

Vernacular names. Sabah—*bangkil*, *tanggajun* (Malay). Sarawak—*bangkil* (Kenyah), *buah klidang* (Murut), *kateh*, *kati*, *minggi*, *pinggi* (Iban).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Aru Is., Papua New Guinea, Bismarck Archipelago, and Solomon Islands. *P. venenosus* subsp. *borneensis* is very common in Sabah and Sarawak, while the other 2 subspecies are uncommon. Also in Brunei and Kalimantan.

Ecology. In lowland to lower montane forests, including peatswamp forest, at 300–1500 m altitude, on yellow clayey soils. Flowering and fruiting from February–November.

Uses. The latex is used for preparing arrow poison. Ripe fruit is edible but the unripe seeds are poisonous.

Key to subspecies

1. Leaves thin-coriaceous; intercostal veins visible on both surfaces. Syncarp with truncate or obtuse depressed processes..

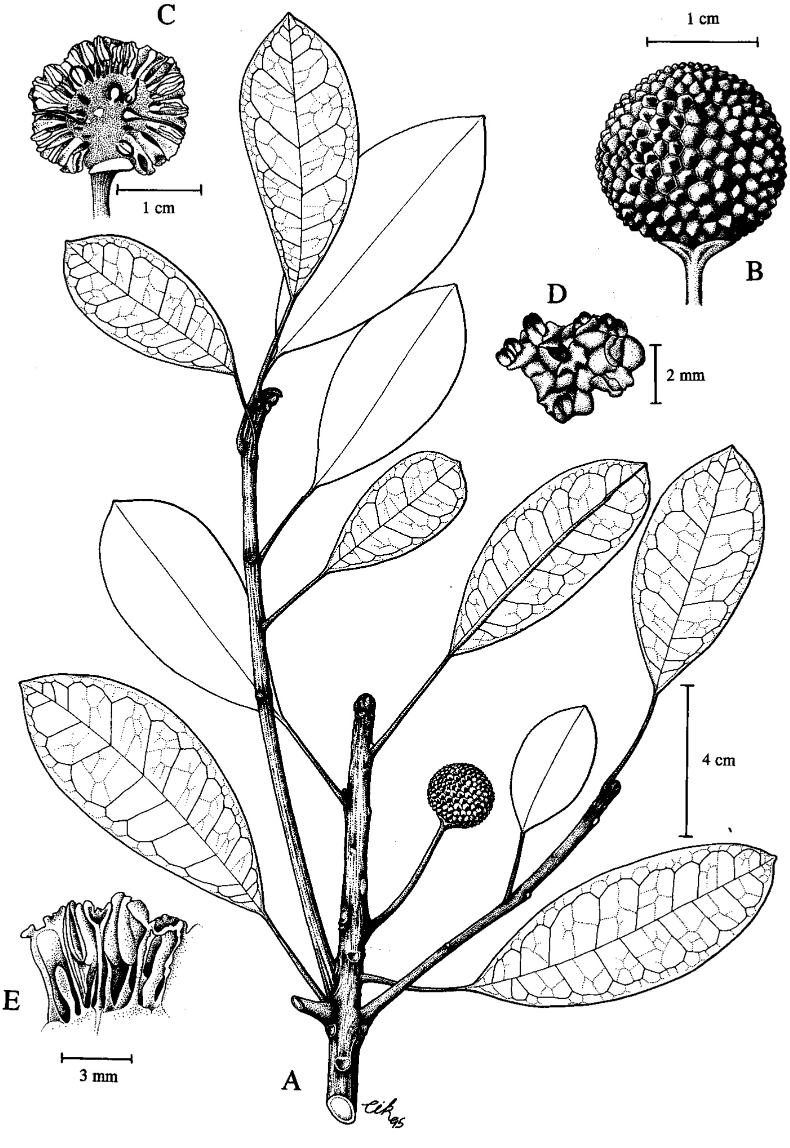

Fig. 14. *Parartocarpus venenosus*. A, leafy twig with bisexual inflorescence head; B, bisexual inflorescence head; C, longitudinal section of bisexual inflorescence head; D, male and female flowers at anthesis; E, a group of male flowers. (From *Nooteboom & Chai 2124.*)

subsp. **venenosus**

In Sabah very rare, known only by 2 collections, *SAN 37723* and *SAN 57831*. Leaves thick-coriaceous; intercostal veins invisible on both surfaces. Syncarp with spine-like processes.......…………………..….............……..…………………………...2

2. Leaf base cuneate; midrib not sunken above. Syncarp peduncle 3–4 cm long. Confined to peatswamp forest..........………………………………….……....……………………

subsp. **forbesii** (King *ex* Hook. *f.*) Jarrett

(H.O. Forbes, 1851–1932, Scottish botanist)

J. Arn. Arb. 41 (1960) 137; Kochummen *l.c.*165; Primack *l.c.* 122; Whitmore, Tantra & Sutisna *l.c.* 260; Turner *l.c.* 356; Coode *et al.* (eds.) *l.c.* 220. Basionym: *Artocarpus forbesii* King *in* Hooker *f.*, Fl. Brit. Ind. 5 (1888) 539; Ridley *l.c.* (1924) 352. Type: *King 10829*, Peninsular Malaysia (CAL, K, P). Synonym: *P. excelsa* Becc. *l.c.* 634; *Gymnartocarpus triandra* J.J. Smith, Bull. Jard. Bot. Buitenz. 3, 4 (1922) 233; *P. triandra* (J.J. Smith) J.J. Smith, Bull. Jard. Bot. Buitenz. 3, 6 (1924) 80, Browne, FTS (1955) 357.

Leaves thick-coriaceous; obovate, elliptic, oblanceolate to oblong, 8–13 × 4–6 cm, *base cuneate*; *midrib prominent above* and raised beneath; lateral veins 6–10 pairs, appressed short-hairy below, glabrescent. Male inflorescences globose; peduncle 1.2–3.5 cm long. Syncarps with spine-like or umbonate processes; *peduncle 3–4 cm long*.

Sumatra, Malay Peninsular and Borneo. In Sarawak known only from peatswamp forest. Also in Brunei and Kalimantan.

Leaf base rounded to cuneate; midrib sunken above. Syncarp peduncle 4–8 cm long. Not found in peatswamp forest…....……………………….……………........……………

subsp**. borneensis** (Becc.) Jarrett

(of Borneo)

J. Arn. Arb. 41 (1960) 332; Anderson *l.c.* 262; Primack *l.c.* 123; Whitmore, Tantra & Sutisna *l.c.* 260; Coode *et al.* (eds.) *l.c.* 220. Basionym: *P. borneensis* Becc. *l.c.* 634. Type: *Beccari PB 2005*, Borneo, Sarawak (FI, K).

Leaves thick-coriaceous, glabrous and dark brown above, *sparsely hairy with rusty minute stiff hairs below*; obovate to elliptic, *(6–)8–10(–12) × 5–7 cm*, *base rounded to cuneate*, margin entire, slightly revolute, *apex rounded, notched or emarginate to acute*; *midrib sunken above*, raised beneath; lateral veins 8–11 pairs, prominent below; petiole 4–7 cm long, sparsely covered by stiff short hairs. Male inflorescences globose, *c.* 2 cm diameter; peduncle 3–5 cm long, sparsely short-hairy. Female inflorescences globose, about the same size as the males, sparsely short-hairy. *Syncarps* up to 8 cm diameter, *spinulous*, yellowish green when mature; *peduncle 4–8 cm long*; bracts 4, persistent.

Endemic to Borneo. Very common in Sabah and Sarawak. Also in Brunei and Kalimantan. In lowland and hill mixed dipterocarp forests, on ridges and hill slopes, on yellow clayey soils, at 300–1000 m altitude. Flowering and fruiting from February–November. Fruits edible.

5. **PRAINEA** King

(David Prain, 1857–1944, former curator of the Herbarium,
Royal Botanic Gardens, Culcutta, India)

selangking (Iban, Malay)

Rusea Go

In Hooker *f.*, Fl. Brit. Ind. 5 (1888) 546; Beccari, For. Born. (1902) 635; Ridley, FMP 3 (1924) 358; Jarrett, J. Arn. Arb. 40 (1959) 30; Burgess, TBS (1966) 399; Kochummen, TFM 3 (1978) 165; Anderson, CLTS (1980) 262; Primack, Forester's Guide to the Moraceae of Sarawak (1983) 124; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 260; Rohwer *in* Kubitzki *et al.* (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 448; Coode *et al.* (eds.), CLBD (1996) 220; PROSEA 5, 3 (1998) 469.

Trees or woody climbers (not in Sabah and Sarawak), *unarmed*, *monoecious or dioecious*. **Bark** reddish brown; slash with milky white latex. **Stipules** paired, *lateral or intrapetiolar*, *non-amplexicaul*. **Leaves** simple, *spirally arranged or distichous*, penninerved; lateral veins distinctly looping near the leaf margin. **Inflorescences** *unisexual*, *capitate*, peduncled, solitary or paired in the leaf axils; flowers among numerous peltate, clavate, or spathulate interfloral bracts; perianth free, enclosing a single stamen or ovary; *involucral bracts absent*. **Male inflorescences** with numerous flowers; male flowers: perianth tubular, bilobed or perforated above, stamens shortly exserted. **Female inflorescences** with fewer flowers; female flowers: perianth tubular, clavate, fleshy above, the mouth contracted, very shortly 4-lobed or merely perforated, ovary unilocular, style apical, bifid, the arms exserted, ovules subapical. **Syncarps** subglobose to ellipsoid; *perianth strongly enlarged*, *projecting from the syncarp surface*, fleshy, globose to ellipsoid. **Fruits** drupaceous, large, attached laterally near the base of the syncarp, interfloral bracts persistent. **Seeds** without endosperm; embryo straight, cotyledons equal fleshy; radicle and plumule minute, apical.

Distribution. Four species, distributed in Sumatra, Peninsular Malaysia, Borneo, Maluku, and Papua New Guinea. In Sabah and Sarawak two species are found, of which one is endemic to Borneo (*Prainea frutescens*).

Ecology. Mostly found in lowland and hill forests, below 1000 m altitude.

Uses. Source of medium hardwood for local use.

Key to *Prainea* species

Leaves 5–16 × 3–7 cm, thin-coriaceous to chartaceous. Syncarp with a peduncle 1.3–1.6 cm long……………………………………………………………**1. P. frutescens**

Leaves 10–35 × 4–15 cm, thick-coriaceous. Syncarp with a peduncle 7.5–11.5 cm long………………………………………………………………**2. P. limpato**

1. **Prainea frutescens** Becc.

(Latin, *frutescens* = shrubby; the habit)

For. Born. (1902) 635; Corner *l.c.* (1962) 242; Anderson *l.c.* 262; Primack *l.c.* 125; Whitmore, Tantra & Sutisna *l.c.* 261. **Type:** *Beccari PB 667*, Borneo, Sarawak (holotype FI; isotypes K, P). **Synonym:** *Artocarpus frutescens* (Becc.) Renner, Engl. Bot. Jahrb. 39 (1907) 367.

Tree up to 30 m tall, 40 cm diameter; with short, rounded buttresses or without buttresses. **Bark** grey, becoming brownish or reddish near the buttresses, smooth; inner bark reddish. **Sapwood** yellowish. Young **twigs** sparsely hairy or puberulent, older ones glabrescent to glabrous. **Leaves** *thin-coriaceous to chartaceous*, glabrous on both surfaces; obovate, elliptic to oblong, *5–16 × 3–7 cm*, base cuneate, rarely asymmetric, margin entire, plane, apex abruptly contracted into narrow acumen *c.* 2 cm long; midrib prominent below; lateral veins obscure, 6–10 pairs, looping near the leaf margin; intercostal venation reticulate, obscure on both surfaces; petiole slender, up to 1.2 cm long. **Inflorescences** solitary. **Male inflorescences** subglobose, 0.4–0.6 cm diameter; peduncle 0.5–1.2 cm long. **Male flowers:** perianth 0.8–1 mm long, minutely pubescent; stamens slender, *c.* 1.2 mm long, filament cylindrical, anthers oblong, up to 0.2 mm long; bracts with minute stalk. **Female inflorescences** globose, up to 1 cm diameter, each bearing at least 20–30 flowers and numerous bracts. **Syncarps** globose, up to 1.5 cm diameter, compactly covered by 20–30 developing female flowers and numerous bracts; fruiting perianth ovoid, *c.* 6 mm diameter, projecting up to 7 mm long, apices obtuse, mouth shortly bilobed; bracts connate in groups; *peduncle 1.3–1.6 cm long*. **Fruits** ripening red.

Vernacular names. Sarawak—*selangking* (Malay), *selangking batu* (Iban).

Distribution. Endemic to Borneo. In Sabah uncommon; in Sarawak only known from the west and northern parts. Not known in Brunei.

Ecology. In primary lowland mixed dipterocarp forest, up to 300 m altitude, including heath forest (*kerangas*) on yellow sandy or brownish soils. Flowering either in February–March or from October–November; fruiting in June–August or November–December, February and April.

2. **Prainea limpato** (Miq.) Beumee *ex* Heyne Fig. 15.

(Sumatran plant name—*limpatu*)

Nutt. Pl. Ned. Ind., ed. 2, 1 (1927) 579; Jarrett *l.c.* (1959) 34; Burgess *l.c.* 399; Kochummen *l.c.* 673; Anderson *l.c.* 262; Primack *l.c.*126; Whitmore, Tantra, Sutisna *l.c.* 261; Coode *et al.* (eds.) *l.c.* 220. **Basionym:** *Artocarpus limpato* Miq. Fl. Ind. Bat., Suppl. (1861) 421. **Type:** *Diepenhorst HB 2500*, Sumatra, Priaman (holotype U; isotype L), **Synonyms:** *Urostigma diepenhorstii* Miq. *l.c.* (1861) 439; *Ficus diepenhorstii* (Miq.) King, Ann. Roy. Bot. Gard. Calc. 1, 2 (1888) 181; *P. cuspidata* Becc. *l.c.* 636; *P. multinervia* Merr., Philip. Journ. Sci 29 (1926) 364.

Deciduous tree, up to 30 m tall, 40 cm diameter; with or without buttresses. **Bark** greyish to reddish brown, smooth to somewhat scaly and sometimes flaky; inner bark greyish white or pale grey. **Sapwood** pale greenish. **Twigs** rounded or flat, 0.2–0.7 cm thick, appressed puberulent. **Leaves** *thick-coriaceous*; oblong to obovate or elliptic, *10–35 ×*

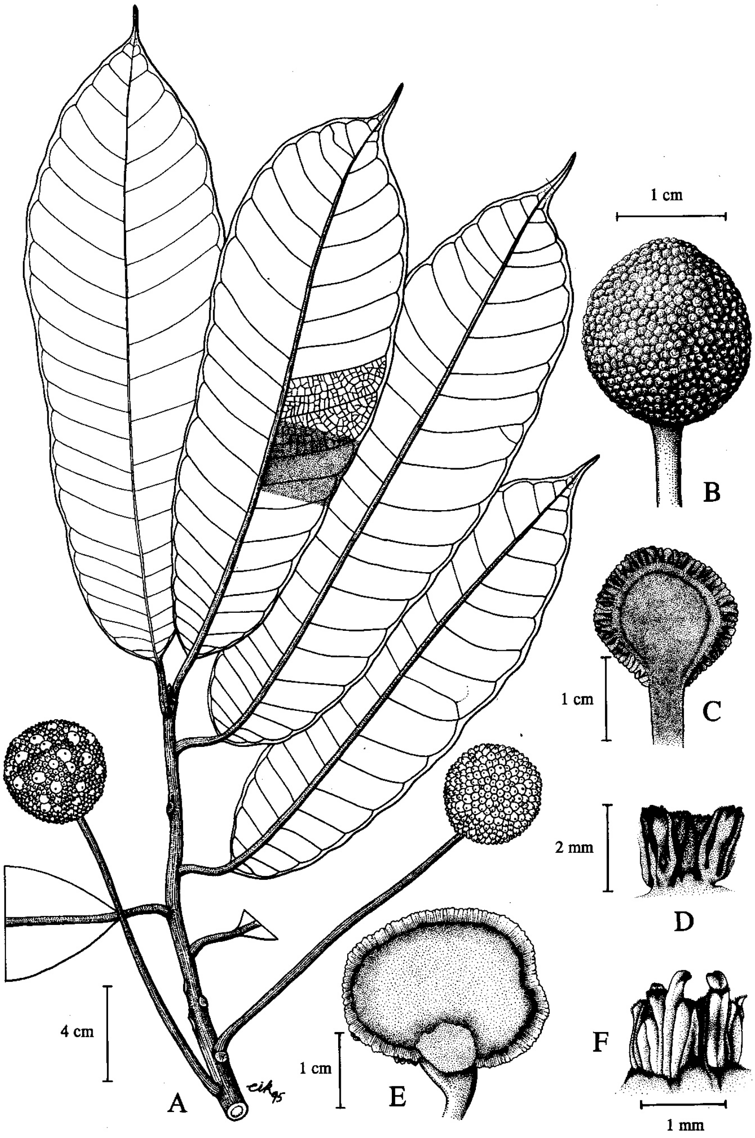

Fig. 15. *Prainea limpato.* A, leafy twig with inflorescence heads; B, female inflorescence head; C, longitudinal section of female inflorescence head; D, female flowers; E, male inflorescence head; F, male flowers. (A–D from *S. 32656*, E–F from *SAN 84666.*)

4–15 cm, base asymmetric, cuneate to rounded, margin revolute, apex abruptly contracted into narrow acumen up to 2 cm long; lateral veins 12–14 pairs, prominently raised beneath, looping near the leaf margin; intercostal venation reticulate, faint to distinct above; petiole up to 3 cm long. **Inflorescences** solitary or paired. **Male inflorescences** globose, up to 1.5 cm diameter; peduncle 3–4 cm long, glabrous or short-hairy. **Male flowers:** perianth tubular, perforated, minutely pubescent; stamens *c.* 1.8 mm long, filament cylindrical, anthers oblong, *c.* 0.5 mm long; bracts with slender stalk, ciliate. **Female inflorescences** globose; interfloral bracts abundant, spathulate or with peltate upper parts, densely or sparsely hairy. **Syncarps** up to 5.5 cm diameter, very irregularly shaped, loosely covered by numerous bracts, yellow-green, drying brown; fruiting perianth 8–20 per head, projecting to 15–20 mm, ellipsoid, *c.* 10 mm diameter, obtuse or broadly attenuate; *peduncle 7.5–11.5 cm long*, puberulent.

Vernacular names. Sabah—*kasusur aboi*, *kesusu* (Dusun), *kayu susu* (Malay, Sandakan), *tampang* (Malay), *usu* (Dusun, Banggi). Sarawak—*empatak* (Iban), *karen* or *karon* (Bidayuh), *tampang* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah scattered, uncommon; in Sarawak mostly found in Kuching district, uncommon. Also in Brunei and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests on loamy, sandstone-derived or sandy soils, on limestone ridges and riverbanks, up to 700 m altitude. Flowering May–August; fruiting in August–January.

Use. Source of light hardwood known as *beruni*.

6. **STREBLUS** Lour.

(Greek, *streblos* = crooked or distorted; referring to the twigs)

gili-gili (Bassap-Malbuh, Sabah); *tempinis* (Malay)

Rusea Go

Fl. Cochinch. (1790) 615; Ridley, FMP 3 (1924) 323; Corner, Gard. Bull. Sing. 19 (1962) 215, WSTM 3rd. edition 2 (1988) 555; Kochummen, TFM 3 (1978) 167; Anderson, CLTS (1980) 262; Primack, Forester's Guide to the Moraceae of Sarawak (1983) 125; Berg, Proc. Kon. Ned. Akad. Wetensch. C 91 (1988) 356; Rohwer *in* Kubitzki *et al.* (eds.), Fam. & Gen. Vasc. Pl. 2 (1993) 446; Coode *et al.* (eds.), CLBD (1996) 220; PROSEA 5, 3 (1998) 537. **Synonyms:** *Bleekrodea* Blume, Mus. Bot. Lugd.-Bat. 2 (1856) 87; *Paratrophis* Blume *l.c.* (1856) 81; *Taxotrophis* Blume *l.c.* (1856) 77; *Sloetia* Teijsm. & Binnen. *ex* Kurz, J. Lin. Soc. Bot. 8 (1864) 168; *Pseudostreblus* Bureau *in* A. DC., Prodr. 17 (1873) 219; *Pseudotrophis* Warb., Bot. Jahrb. 13 (1891) 294.

Monoecious or dioecious, small to medium-sized trees or climbers (not in Sabah and Sarawak), *unarmed or with spines*. **Bark** of various shades from pale to black, smooth, sometimes lenticellate or finely flaky; inner bark creamy white, yellowish to greenish; latex white to yellowish. **Leaves** *distichous*, *simple*, mostly oblong, elliptic to lanceolate.

Inflorescences axillary, *bisexual or unisexual*, *cymose*, *racemose*, *spicate or capitate*. **Female flowers** solitary or paired, 4-merous; tepals free or joined; ovary superior. **Male flower** *with pistillode*, 3–5-merous, mostly 4-merous; tepals free or joined, stamen filaments inflexed in bud, anthers small, kidney-shaped, extrorse. **Fruits** *simple*, *drupaceous*, sometimes with fleshy base, *with persistent tepals which are enlarged or not.*

Distribution. About twenty species in Asia, Australia, Madagascar, and Africa; with 15 species in Malesia, and 4 species in Sabah and Sarawak.

Ecology. Mostly found in lowland and hill forests, up to 900 m altitude.

Key to *Streblus* species

1. Twigs and stem spiny……………………………………..….….….….**3. S. ilicifolius**
   Twigs and stem not spiny……………………………………..…………..……...2

2. Leaf margin serrate to crenate; lateral veins 5–6 pairs……………....**4. S. macrophyllus**
   Leaf margin entire or undulate; lateral veins 6–18 pairs………………………………..3

3. Lateral veins 13–15 pairs. Inflorescences bisexual spikes or catkins, 5–6 cm long. Fruits with fleshy base, covered by enlarged tepals.......…………………**1. S. elongatus**
   Lateral veins 9–18 pairs. Inflorescences unisexual; males in cluster of 2–10, females either solitary or paired in leaf axils. Fruits without fleshy base, tepals not enlarged…………………………………………………...……………**2. S. glaber**

1. **Streblus elongatus** (Miq.) Corner

(Latin, *elongatus* = elongate; the elongated inflorescences)

Gard. Bull. Sing. 19 (1962) 227, *l.c.* (1988) 556; Kochummen *l.c.* 168; Primack *l.c.* 128; Turner *l.c.* 356. **Basionym:** *Artocarpus elongatus* Miq., Fl. Ind. Bat., Suppl. (1861) 419. **Type:** *Teijsmann s.n.*, N Sumatra, Lumut, W Siboga (L?, U?). **Synonyms:** *Sloetia sideroxylon* Teijsm. & Binnen. *ex* Kurz *l.c.* 168; *S. pinangeana* D. Oliver *in* Hooker, Ic. Pl. (1886) *t.*1531; *S. wallichii* King *in* Hooker *f.*, Fl. Br. Ind. 5 (1888) 493; *S. elongata* (Miq.) Koord., Exk. Fl. Java 2 (1912) 90.

Monoecious tree, up to 35 m tall, 50 cm diameter, *unarmed*. **Bark** rough, grey-brown; inner bark soft, reddish; latex white. **Sapwood** yellowish white. **Twigs** glabrous, 0.15–0.25 cm thick, greyish brown, lenticellate. Terminal buds conical, *c.* 0.1 × 0.15 cm. **Stipules** paired, 0.5–1.5 cm long, caducous, scars incompletely ring-like. **Leaves** thin-coriaceous, glabrous on both surfaces; elliptic or obovate, (7–)10–20(–26) × (3–)5–8(–10) cm, base asymmetric, cuneate, *margin entire or undulate*, revolute, apex acuminate, acumen up to 1.5 cm long; midrib prominently raised above; *lateral veins* prominent on both surfaces, *13–15 pairs*; intercostal venation reticulate, prominent below; petiole 0.5–1.5 cm long, glabrous. **Inflorescences** *bisexual or male*, *axillary pendent spikes*, *5–6 cm long*, solitary or in clusters of 2–4; male flowers numerous; female flowers 1–5 per inflorescence. **Male flowers** *sessile*; *tepals 3(–4)*; stamens 3(–4), 2–2.5 mm long, white; *pistillode conical*. **Female flowers** mostly at the base of the spike; tepals 4; style up to 5 mm long, stigmatic arms 12–20 mm long. **Fruits** round, 0.8–1.2 cm diameter, *with fleshy base, enclosed by the enlarged tepals.*

Vernacular name. Sarawak—*tempinis* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Borneo, and Sulawesi. Uncommon in Sabah and Sarawak. Not known in Brunei.

Ecology. In lowland and hill forests on yellow loam soils, up to 800 m altitude.

Use. The standard Malaysian name for the timber is *tempinis*. It is very hard and very heavy, suitable for all forms of heavy construction.

2. **Streblus glaber** (Merr.) Corner Fig. 16.

(Latin, *glaber* = without hairs; the plant parts)

Gard. Bull. Sing. 19 (1962) 221; Kochummen *l.c.* 168; Anderson *l.c.* 263; Primack *l.c.* 129; Turner *l.c.* 356; Coode *et al.* (eds.) *l.c.* 220. **Basionym:** *Gironneira glabra* Merr., Philip. J. Sci. 1 (1906) Suppl. 42. **Type:** *Whitford 1205*, the Philippines, Luzon, Mt. Mariveles, Lamao R. (holotype K). **Synonyms:** *Aphananthe negrosensis* Elmer, Leafl. Phil. Bot. 2 (1909) 575; *Pseudostreblus caudatus* Ridl., J. Fed. Mal. Str. Mus. 6 (1915) 54; *Paratrophis glabra* (Merr.) Steenis, J. Bot. 72 (1934) 8; *Streblus laevifolius* Diels, Bot. Jahrb. 67 (1935) 171; *Chevalierodendron glabrum* (Merr.) Leroy, C.R. Acad. Sc. Paris 227 (1948) 146.

Dioecious tree, up to 40 m tall, 60 cm diameter, *unarmed*. **Bark** smooth, dark grey to brown; latex white. **Twigs** up to 0.2 cm thick, often somewhat flattened, greyish brown to blackish, smooth. **Stipules** paired, 0.2–0.5 cm long, caducous. **Leaves** thin-coriaceous, glabrous; lanceolate, (5–)7–10(–12) × 2–3 cm, base cuneate, *margin entire*, *plane*, apex sharply acuminate, acumen up to 2 cm long; midrib prominent on both surfaces; *lateral veins 9–18 pairs*, prominent on both surfaces; intercostal venation reticulate, often slightly raised beneath; petiole less than 1 cm long. **Inflorescences** *unisexual*; bracts ovate, lanceolate or reniform. **Male inflorescences** *unbranched*, 3–30-flowered, *clustered in groups of 2–10*, 1–2.5 cm long; peduncle up to 1 cm long, red when fresh. **Male flowers** sessile, 4-merous; tepals reddish, stamens whitish, inflexed, *pistillode columnar*, *4-angled*. **Female inflorescences** *solitary or paired in the leaf axils*, 1–9-flowered; peduncle 1–2 cm long. **Female flowers:** tepals ovate, obtuse, 1–3 mm across; style *c.* 1 mm long, stigmatic arms 1.5–4 mm long. **Fruits** pyriform, up to 1 cm diameter, *without fleshy base*, glabrous, ripening dark purple, turning to black on drying; *tepals persistent, not enlarged.*

Vernacular name. Sarawak—*selangking* (Iban).

Distribution. Peninsular Malaysia, Borneo, the Philippines, Sulawesi, New Guinea, and Solomon Islands. In Sabah and Sarawak uncommon. Also in Brunei and Kalimantan.

Ecology. In hill to upper montane forests, mostly on ridges with brown to blackish soils, up to 2500 m altitude. Flowering from January–May; fruiting from March–August.

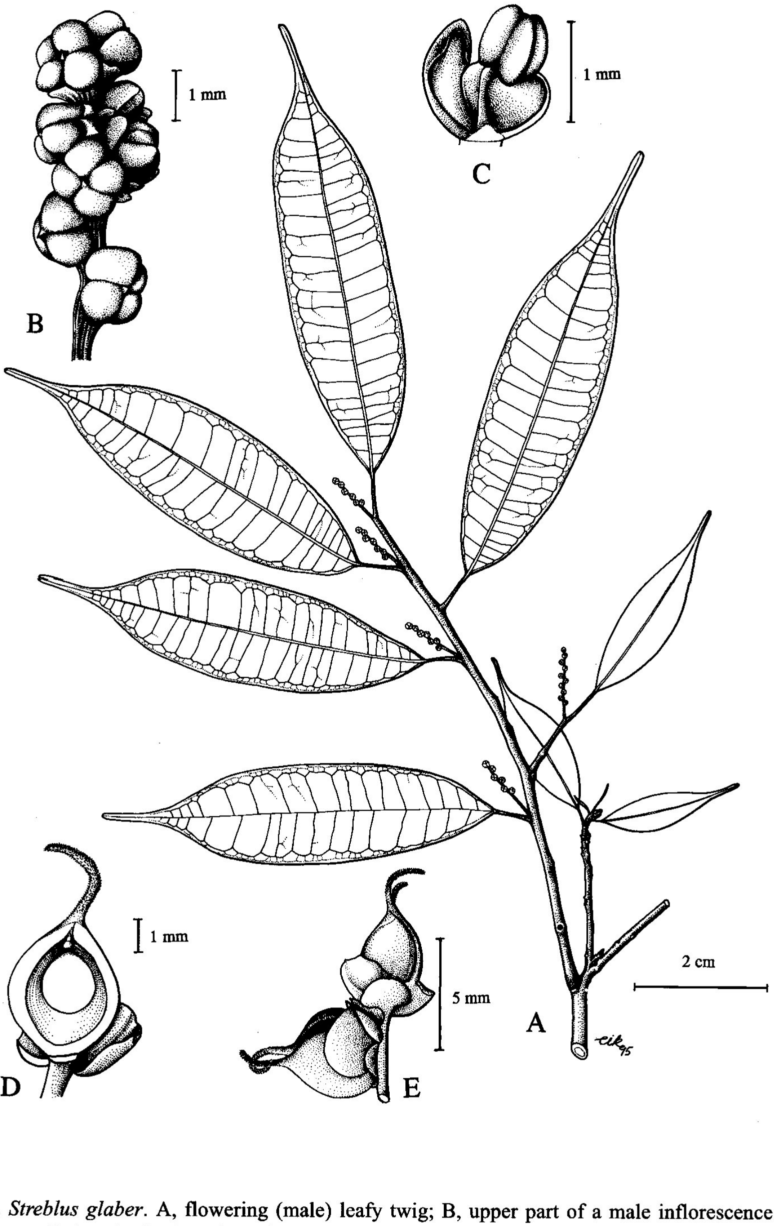

Fig. 16. *Streblus glaber*. A, flowering (male) leafy twig; B, upper part of a male inflorescence; C, male flower; D, longitudinal section of female flower; E, female inflorescence. (A–C from *S. 36123*, D–E from *SAN 56720*.)

3. **Streblus ilicifolius** (Vidal) Corner

(having leaves resembling those of the holly tree—*Ilex*)

Gard. Bull. Sing. 19 (1962) 227, *l.c.* (1988) 557; Kochummen *l.c.* 167; Turner *l.c.* 356. **Basionym:** *Taxotrophis ilicifolia* Vidal, Rev. Pl. Vasc. Filip. (1886) 249; Ridley *l.c.* (1924) 322. **Lectotype** (Chew, *ined.* 1959)**:** *Vidal 1795*, the Philippines, Isle of Marinduque (holotype P?). **Synonyms:** *Pseudotropis laxifolia* Warb., Bot. Jahrb. 13 (1891) 294; *Taxotropis obtusa* Elmer, Leafl. Philip. Bot. 5 (1913) 1813; *T. triapiculata* Gamble, Kew Bull. (1913) 188.

Dioecious tree, up to 10 m tall, 15 cm diameter, *spiny*. **Bark** greyish black, smooth and lenticellate; inner bark yellowish with white to yellowish latex. **Twigs** 0.1–0.3 cm thick, grey-brown. **Stipules** triangular, 0.3–0.5 cm long, caducous, *on falling leaving complete ring-like scars*. **Leaves** thick-coriaceous, glabrous on both surfaces; elliptic, oblong, or obovate, (4–)6–12(–15) × (2–)4–8(–10) cm, base rounded, *margin with sharp*, *spine-like serration or undulate*, apex acuminate; midrib raised on both sides; lateral veins 8–12 pairs, joining near the leaf margin to form looped intramarginal veins, flattish to slightly sunken above, raised below; intercostal venation reticulate, faint on both surfaces; petiole 0.2–1 cm long. **Inflorescences** axillary, *unisexual*. **Male inflorescences** spicate, unbranched, 1–5 cm long, with many flowers; bracts reniform, 2–3 mm wide. **Male flowers** 4-merous, tepals up to 1.5 mm long, pistillode 4-angled. **Female inflorescences** racemose with 3–6 flowers, 1–4 cm long; peduncle 0.3–1.5 cm long; bracts reniform. **Female flowers** pedicelled; tepals 2–4 mm long; style up to 1 mm long, stigmatic arms 2–3.5 mm long. **Fruits** ovoid to cylindrical, 0.6–0.8 cm diameter, with acute tip, *seated on a very thick fleshy base*, *more or less covered by the enlarged tepals*.

Vernacular name. Sabah—*nunuk daun berduri* (Malay).

Distribution. Chittagong, Burma, Indo-China, Thailand, Hainan, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Maluku, Key Is., and Timor. In Sabah and Sarawak uncommon and scattered. So far no record for Brunei and Kalimantan.

Ecology. In primary and secondary forests on sandy, black, or rocky ultrabasic soils, frequently on hillsides or rocky ridges. Flowering in June–October; fruiting from November–February.

4. **Streblus macrophyllus** Blume

(Greek, *makro* = large, *phullon* = leaf; large-leaved)

Mus. Bot. Lugd.-Bat. 2 (1856) 80; Corner *l.c.* (1962) 227; Kochummen *l.c.* 168; Turner *l.c.* 357. **Type:** *Teijsmann s.n.* (= *RHL Sheet No. 908189706*), Sulawesi, near Likupang (holotype L). **Synonyms:** *Taxotrophis macrophylla* (Blume) Boerl., Handl. 3 (1900) 359; *Pseudotrophis mindanaensis* Warb. *in* Perkin, Fragm. Fl. Filip. 1 (1904) 165; *Paratrophis caudata* Merr., Philip. J. Sci. 1 (1906) Suppl. 183; *Taxotrophis balansae* Hutch., Kew Bull. (1918) 151.

Dioecious or sometimes monoecious *tree*, up to 10 m tall, 15 cm diameter, *unarmed*. **Bark** finely flaky, whitish brown or yellowish to greenish. **Twigs** 0.1–0.2 cm thick, yellowish grey. **Stipules** 0.2–1 cm long, subpersistent or caducous. **Leaves** thin-coriaceous, glabrous on both surfaces; ovate to oblanceolate, (4–)7–12(–15) × (1.5–)3–4(–6) cm, base cuneate to rounded, *margin serrate to crenate*, apex cuspidate, acumen up to 2.5 cm long; midrib flat above, distinct and raised below; *lateral veins 5–6 pairs*, slightly raised beneath; intercostal venation reticulate, obscure on both surfaces; petiole up to 0.3 cm long. **Inflorescences** axillary, solitary, *unisexual*. **Male inflorescences** spicate, 4–14 cm long, puberulous; peduncle 0.2–0.4 cm long; bracts subreniform to semicircular, 0.3–0.5 mm long. **Male flowers** sessile; tepals *c.* 1 mm long; pistillode 4-angled. **Female inflorescences** racemose, 2–3 cm long, 2–10-flowered, glabrous; peduncle 0.2–1 cm long. **Female flowers** with pedicel up to 1 cm long; style 2–3 mm long, stigmatic arms 1.5–5 mm long. **Fruits** ripening to reddish yellow, up to 1.5 cm long, *thinly fleshy at the base*.

Vernacular names. Sabah—*kamuning* (Malay, Sandakan), *lampasih* (Malay, Keningau).

Distribution. Indo-China, Peninsular Malaysia, Borneo, Sulawesi, and the Philippines. In Borneo, so far only known from Sandakan and Keningau districts, Sabah.

Ecology. In lowland forest near riverbanks, on hill tops and slopes on brown soils. Flowering and fruiting all year round.

MYRISTICACEAE

W.J.J.O. de Wilde

Rijksherbarium/Hortus Botanicus,
Leiden, the Netherlands

Gamble, J. As. Soc. Beng. 75, 2 (1912) 205; Merrill, EB (1921) 268; Ridley, FMP 3 (1924) 53; Masamune, EPB (1942) 300; J. Sinclair, Gard. Bull. Sing. 16 (1958) 205; Backer & Bakhuizen *f.*, FJ 1 (1964) 137; Burgess, TBS (1966) 407; Whitmore, TFM 1 (1972) 315; Anderson, CLTS (1980) 263; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 262; Turner, Gard. Bull. Sing. 47, 2 (1995) 357; Coode *et al.* (eds.), CLBD (1996) 220; Argent *et al.* (eds.), MNDT-CK 2 (1997) 445.

Dioecious, or monoecious (*Endocomia*), or rarely paroecious (in a few species of *Myristica*), monopodial trees occasionally with stilt roots or buttresses; crown often pyramidal. **Branches** more or less horizontal and whorled. **Bark** brown or black (most species of *Myristica*), smooth, fissured or flaky; inner bark fibrous, reddish brown; sap red. **Sapwood** white, soon brownish on exposure, soft; rays narrow, tanniferous tubes present; growth rings usually distinct and visible to the unaided eye. **Twigs** striate or smooth, often lenticellate, their apical portions often tomentose. **Leaves** simple, entire, alternate, often appearing distichous, exstipulate, often tomentose on both surfaces when young and later glabrous or sometimes remaining tomentose on the lower surface; lateral veins distinct, generally anastomosing near the leaf margin. **Inflorescences** axillary or borne on older branches and stems, branched or unbranched panicles of subumbels, or fascicles of flowers borne on scar-covered woody brachyblasts (in *Knema* and partly in *Myristica*); bracts present, often caducous; bracteole absent or present; pedicels usually present. **Flowers** radially symmetrical; buds mostly more or less campanulate, or subglobose, that of female flowers usually larger than those of male ones, inside cream or red, often hairy outside, sometimes fragrant; perianth gamophyllous, sometimes splits to the base, 2–5-lobed, lobes valvate. **Male flowers:** stamens united into an elongated, globose, or pyramidal column, stalked or sessile; anthers 2–45, extrorse, 2-loculed, adnate to the column, the latter sometimes (*Knema*) expanded into a disc. **Female flowers:** ovary superior, unilocular, subglobose, style almost absent, stigmas 2, with few to many laciniations; ovule 1, anatropous, placentation sub-basal. **Fruits** subglobose to oblong, dehiscing by a circumferential suture into 2 valves; pericarp coriaceous or fleshy, glabrous or hairy, sometimes lanose, ripening yellow or red. **Seeds** single, large, hard, conform to the fruits; endosperm hard, mostly ruminate; aril red or orange-red, waxy or fleshy, covering the seed, variously laciniate or entire.

Vernacular names. Preferred trade name—*penarahan*. Sabah—*darah-darah* (preferred name). Sarawak—*binarah* (Murut), *bindara* (Kelabit), *jela bala* (Kenyah), *kayo bela* (Kayan), *kayo raha* (Berawan), *kumpang* (preferred name), *pang* (Bidayuh), *pendarahan*, *pumpu* (Bidayuh Sadong), *raha meban* (Punan Tutoh).

Distribution. A pantropical family comprising 20 genera and *c*. 500 species. In Sabah and Sarawak the family are represented by 5 genera with *c*. 110 species, of which several species are local endemics.

Ecology. The Myristicaceae is a family of rain forest of mainly low and medium altitudes. Sometimes they constitute a considerable component of the forest, especially of the middle storey of the lowland rain forest, but not gregarious. Few species are confined to the mountains. Flowering and fruiting generally throughout the year. Pollination presumably is by insects (e.g., small beetles). The blackish seed, contrasting with the red aril and the yellow or brown or pink opened pericarp, attracts birds (e.g., forest pigeons), which disperse the seeds.

Uses. The timber, traded under the preferred name *penarahan*, is mostly soft or moderately hard and moderately heavy, not durable, but easily treated with preservatives. It is easy to work with, but sometimes easily splitting. The sapwood is pale, not well defined, and the heartwood is often dark reddish brown. The wood is mainly used for light construction work, partitioning, flooring, wall-panelling, moulding and other types of interior finishing, and for making tool-handles, woodcrafts, match boxes and splints, packing cases, crates, and household utensils. It is also suitable for manifacturing plywood, rotary veneer and wrapping and writing papers. The seed (with endosperm) of *Myristica fragrans* is the nutmeg of commerce (*pala*), while the aril around the seeds supplies the mace. Seeds of some *Knema* species contain oil that is locally used to light lamps.

Taxonomic notes. All members of the Myristicaceae can be recognized in the field by their general habit, i.e. slender bole, with monopodial crown, with the branches more or less verticillate and tiered, the longish exstipulate distichous leaves, like in the Annonaceae. These latter differ in flower structure, fruit, and lack the red exudate of the cut bark. Further differences are obvious in the transversely cut twig where the bark has radiating parenchyma in the Annonaceae, and also the pollen is different. The genera of Myristicaceae can be told apart on vegetative characters only with special experience, and flower, inflorescence and fruit characters are necessary for a definite identification. Useful characters are the non-striate, usually finely lenticellate and granulate bark of the twigs in *Gymnacranthera*, or the dry leaves not readily breaking up into pieces in most of *Knema* and *Gymnacranthera*. Certain leaf and wood anatomical characters are diagnostic of a particular genus. Since myristicaceous specimens are either male (staminate) flowering, or female (pistillate) flowering and/or fruiting, keys have been constructed for both sexes, using also certain vegetative characters. However, specimens with only pistillate flowers may be problematic to assign to a particular genus, and one should search and attempt within both keys, using especially the type of inflorescence.

Key to genera

(for male flowering specimens)

1. Inflorescences sessile or short-peduncled fascicles of flowers borne on brachyblasts (= short, tubercle-like, usually woody shoots) bearing scars of fallen pedicels and bracts; bracteole present……………………………………...………….…………….2
   Inflorescences branched, short- or long-peduncled panicles, with distal parts of the branches woody and bearing scars or not; bracteole present or absent.........……3

2. Androecium comprising a staminal disc to which the anthers are radially attached by their bases, and a cylindrical or tapering stalk or staminal column. Bracteole minute, situated at the base or at about the middle part of the pedicel..............................**4. Knema**
Androecium consisting of an elongated synandrium made up of a thickish central column to which anthers are adnate by their backsides, a sterile apex and a stalk or androphore. Bracteole embracing the flower bud, inserted at or near the top of the pedicel..**5. Myristica** (in part)

3. Bracteole present, inserted at or near the top of the pedicel. Inflorescences with scar-covered perennial distal portions present or absent.......................**5. Myristica** (in part)
Bracteole absent. Inflorescences not as above..4

4. Synandrium (comprising a swollen, solid or excavated column to which elongated anthers are completely or partially adnate by their backsides) subsessile or short-stalked, broadly ellipsoid or almost globose, usually considerably broader than the stalk or androphore. Perianth inside glabrous, lobes not spreading at anthesis. Inflorescences peduncled, not branched from the base...........................**3. Horsfieldia**
Synandrium narrowly elongated or almost globose; the central column at apex excavated or not, narrow, about as wide or narrower than the androphore. Perianth inside or on both sides hairy or papillose-hairy, lobes erect or reflexed at anthesis. Inflorescences usually branched at or near the base...5

5. Synandrium elongated, sessile or very short-stalked; anthers laterally tightly connate and for most of their backsides adnate to the excavated column, with apical free portions. Perianth lobes (in male flowers) erect at anthesis...............**2. Gymnacranthera**
Synandrium short, depressed globose or short-ellipsoid, distinctly stalked (androphore well-developed); anthers short, completely sessile, connate, and adnate to the slender, non-excavated column by their backsides, without free apical portions. Perianth lobes (in male flowers) spreading or reflexed at anthesis..................................**1. Endocomia**

Key to genera

(for fruiting specimens)

1. Aril divided into segments to or almost to the base...2
Aril entire or laciniate (incised) in the apical portion only, for up to halfway from the top...3

2. Infructescences paniculate, usually branched from near the base and with scars of cataphylls at base. Bark of twigs smooth, never distinctly striate. Fruits 1.5–3 cm long. Bracteole absent..**2. Gymnacranthera**
Infructescences either simple or furcate, short, subsessile, or panicle-like with peduncle, without scars of cataphylls at the base. Bark of twigs usually striate, or longitudinally cracked, or flaky. Fruits generally larger. Bracteole (scar) on fruiting pedicel present...**5. Myristica**

3. Aril coarsely laciniate from the upper 1/4–1/2. Seeds usually variegated, often bluntly pointed at the apex. Bracteole absent. Stigma narrowly 2–few-lobed. Inflorescences

paniculate. Trees monoecious...**1. Endocomia**
Aril at apex convoluted or shallowly laciniate. Seeds not variegated, not pointed at one end. Bracteole absent or present. Stigma 2–many-lobed. Inflorescences paniculate or flowers borne on subsessile brachyblasts. Trees dioecious.......................................4

4. Bracteole absent. Inflorescences paniculate. Stigma usually minutely 2-lobed. Leaves when dry usually easily breaking up into pieces; lower surface usually not glaucous..**3. Horsfieldia**
Bracteole present. Inflorescences short, simple or forked, scar-covered, subsessile brachyblasts. Stigma few–many-lobed. Leaves when dry generally not easily breaking up into pieces; lower surface usually more or less glaucous.............................**4. Knema**

1. **ENDOCOMIA** W.J. de Wilde

(Latin, *endo* = inside, within, *coma* = hair tuft; the presence of
hair tuft inside the perianth)

Blumea 30 (1984) 173; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 262; Coode *et al*. (eds.), CLBD (1996) 220; PROSEA 5, 3 (1998) 214.

Monoecious trees. **Twigs** subterete, without lines from petiole to petiole; bark usually not striate, when older longitudinally cracked and sometimes flaky; without lenticels. Terminal leaf buds densely, minutely dull grey-brown pubescent. **Leaves** *distichous*, distinctly petioled, blades not particularly brittle when dry, lower surface not glaucous, without brownish or blackish dots; lateral veins flat to raised above. **Inflorescences** *paniculate*, *usually several times branched at or near the base*, pubescent or glabrescent, with either male or mixed male and female flowers, sometimes the female flowers dominant; at base of peduncle with or without a few minute cataphylls. **Flowers** pedicelled, pubescent or glabrescent, always in umbellate clusters or fascicles with the flowers specifically either all in the same or in different stages of development; *pedicel at base not articulated*; bract caducous; *bracteole absent*; *perianth* membranous to coriaceous, 3–5-lobed, at anthesis clefts to *c*. 3/4 or nearly to the base, greenish or yellowish, *inside papillose-hairy* to various degree, *the lobes in male flowers at anthesis horizontally spreading or more or less reflexed*. **Male flowers:** buds broadly ellipsoid or subglobose, sometimes faintly angular; *synandrium depressed globose or short-ellipsoid*, *central staminal column narrow*, *not wider than the androphore*, *at apex not excavated*; *androphore short to long*, *cylindrical*, *distinct*; *anthers short*, *completely sessile*, *connate*, *and adnate to the staminal column by their backsides*, *without free apical portion*, 2–6, vertical, up to 0.5 mm long, opening extrorsely. **Female flowers:** buds resembling the males; ovary ovoid, glabrous, *stigma* sessile, *narrowly 2–few-lobed*, 0.2–0.3 mm high, the lobes narrow or minutely 2–5-lobulate. **Infructescences** paniculate, up to 30 cm long, bearing a few to many fruits. **Fruits** obovoid or ellipsoid, glabrous; perianth caducous. **Seeds** ellipsoid, *often bluntly pointed at the apex*; *testa usually variegated*; *aril either completely covering or shorter than the seed*, *usually conspicuously deeply laciniated to 1/4–1/2 from the top*.

Distribution. Four species, ranging from S China through SE Asia to Malesia but absent from C and E Java and the Lesser Sunda Islands. In Sabah and Sarawak represented by 3 species.

Ecology. Little is known, possibly not much diverging from that of the family.

Key to *Endocomia* species

1. Male flowers in one cluster or semi-cluster all in about the same stage of development; synandrium depressed globose; androphore shorter than the synandrium, and hence the latter situated close to the bottom of the perianth. Anthers 4. Perianth of male flowers (3–)4–5-lobed. Leaf buds, twig apices and inflorescences rusty pubescent with hairs (0.3–)0.5(–0.7) mm long, sometimes late-glabrescent..………...……**2. E. rufirachis**
   Male flowers in one cluster usually in different stages of development, i.e. flower buds of different sizes; synandrium depressed globose or short-ellipsoid; androphore about as long as or longer than the synandrium, hence the latter usually situated well above the bottom of the perianth. Anthers mostly 3 or 4. Perianth of male flowers 3–4-lobed. Leaf buds, twig apices and inflorescences initially greyish or grey-brown pubescent with minute hairs *c.* 0.1 mm long, early glabrescent.......……………………...2

2. Leaves 8–20 cm long; upper surface drying olivaceous; lateral veins 7–12 pairs. Inflorescences 2–6-flowered. Anthers 3–4. Fruits 4.5–7 cm long; pericarp 5–8 mm thick, drying brown…….……………………….........………………**3. E. virella**
   Leaves 15–35 cm long; upper surface usually drying dark brown; lateral veins 11–24 pairs. Inflorescences 4–10-flowered. Anthers 2–3. Fruits 3.5–4(–5.5) cm long; pericarp 1–3 mm thick, drying blackish.......…………...……………**1. E. macrocoma**

1. **Endocomia macrocoma** (Miq.) W.J. de Wilde Fig. 1F–H.

(Greek, *makro* = large; Latin, *coma* = hair tuft; hairy with long tufted hairs, the twings, leaves and inflorescences)

Blumea 30 (1984) 182, *ibid*. 41 (1996) 375; Whitmore, Tantra & Sutisna *l.c.* 262. **Basionym:** *Myristica macrocoma* Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 207, *ibid.* 2 (1865) 49, *p.p.* (excl. spec. Celeb. = *Horsfieldia irya*). **Lectotype** (W.J. de Wilde, 1984): *Teijsmann 5553*, Maluku, Halmahera (U). **Synonym:** *Horsfieldia macrocoma* (Miq.) Warb., Monogr. Myrist. (1897) 299, J. Sinclair, Gard. Bull. Sing. 16 (1958) 392, *ibid* 23 (1975) 75, *p.p.*, Anderson *l.c.* 265.

subsp. **longipes** W.J. de Wilde
(Latin, *longus* = long, *pes* = foot; the long-stalked synandrium)

Blumea 30 (1984) 185. **Type:** *De Vogel 888*, Borneo, SE Kalimantan (holotype L; isotype K).

Tree up to 20 m tall. **Bark** greyish or chocolate-brown, somewhat fissured or not and little to profusely scaling off in tiny pieces; inner bark 7–17 mm thick, cream or light brown or light brown-red, or yellowish; sap pale orange or reddish, watery. **Sapwood** pale yellow or pale brown. **Twigs** towards apex 2–6 mm diameter, *initially grey-brown to rusty tomentose with hairs c. 0.1 mm long*, *early glabrescent*; bark of lower part tends to be longitudinally cracked, sometimes flaky, lenticels absent or inconspicuous. *Terminal leaf buds* 8–25 mm long, *minutely tomentose with hairs c. 0.1 mm long*. **Leaves** membranous or chartaceous, *upper surface drying dark brown*, glabrous, lower surface glabrescent; elliptic to oblanceolate, *(12–)15–35 × (4–)5–10 cm*, base rounded or attenuate, apex acute-acuminate; midrib flat or slightly raised above; *lateral veins 11–24 pairs*, flat or slightly raised above, interarching connection generally indistinct; intercostal venation sometimes trabeculate, distinct on both surfaces or not; petiole 1–2.5 cm long, glabrescent. **Inflorescences** 6–30 cm long, *early glabrescent or persistently pubescent with hairs c. 0.1 mm long*; peduncle up to 5 cm long; bract 1.5–3 mm long, caducous. **Flowers** arranged in lax or dense umbel-like, widely spaced clusters of 4–10; *flowers in one cluster usually in different stages of development*; *perianth 3–4-lobed*, outside glabrous, early glabrescent or tomentose with thin hairs *c*. 0.1 mm long, lobes inside towards the apex with few to many coarse pale brownish hairs 0.2–0.4 mm long, more or less arranged in rows corresponding with the spaces between the anthers, or sometimes the hairs present only near the lobe-sutures. **Male flowers:** pedicel slender, (2–)4–7 mm long; buds broadly ellipsoid or ovoid, 1.5–2.3 × 1.3–2 mm, apex rounded or subacute, base rounded or attenuate; *perianth 3–4-lobed*, at anthesis clefts to 4/5–5/6, lobes 0.2–0.3(–0.5) mm thick, inside greenish or yellowish when fresh; *synandrium depressed globose*, 0.2–0.3 × 0.2–0.4 mm; *anthers 2 or 3*; *androphore longer than the synandrium*, (0.6–)0.7–1 mm long. **Female flowers:** pedicel 2–6 mm long; buds ovoid-ellipsoid, 2.2–2.6 mm long; ovary narrowly ovoid, 1.3–1.8 mm long, glabrous, stigma 0.2–0.3 mm long, narrowly 2-lipped. **Infructescence** a pendent, loose panicle, (10–)15–30 cm long, bearing 3–12 fruits. **Fruits** narrowly ovoid-ellipsoid, *3.5–4(–5.5) × 1.4–2 cm*, apex blunt or subacute, base rounded or narrowed, glabrous; *pericarp 1–3 mm thick*, *drying blackish*, finely granulate, not or sparingly warted; stalk *c*. 1.5 cm long. **Seeds** *c*. 3 cm long, apex pointed or with a beak up to *c*. 2 mm long; aril at apex laciniate to 1/5.

Vernacular name. Sarawak—*kumpang limau* (Iban).

Distribution. Sumatra and Borneo (Sabah, Sarawak, E and S Kalimantan).

Ecology. In primary mixed dipterocarp forest along stream banks with alluvial or deep clay soils, and on low ridges with sandy, sedimentary soils, up to 1000 m altitude. Flowering and fruiting throughout the year.

2. **Endocomia rufirachis** (J. Sinclair) W.J. de Wilde Fig. 1A–E.

(Latin, *rufus* = reddish; *rachis* = axis; the reddish tomentum on the inflorescence rachis)

Blumea 30 (1984) 192; Whitmore, Tantra & Sutisna *l.c.* 262. **Basionym:** *Horsfieldia macrocoma* (Miq.) Warb. var. *rufirachis* J. Sinclair *l.c.* (1958) 393. **Type:** *Wood SAN A 4770*, Borneo, Sabah (holotype SING, *n.v.*; isotypes K, L, SAN).

Tree up to 40 m tall; buttresses short and rounded. **Bark** usually blackish, brittle, smooth with superficially longitudinal cracks or thinly flaky; inner bark 10–15 mm thick, pale yellow or brown to reddish brown or orange. **Sapwood** pale, whitish to brown-yellow, soft; little pale red exudate from inner sapwood. **Twigs** towards apex 3.5–5 mm diameter, *apex initially rusty tomentose with hairs c. 0.5 mm long*, *late-glabrescent*; bark lower

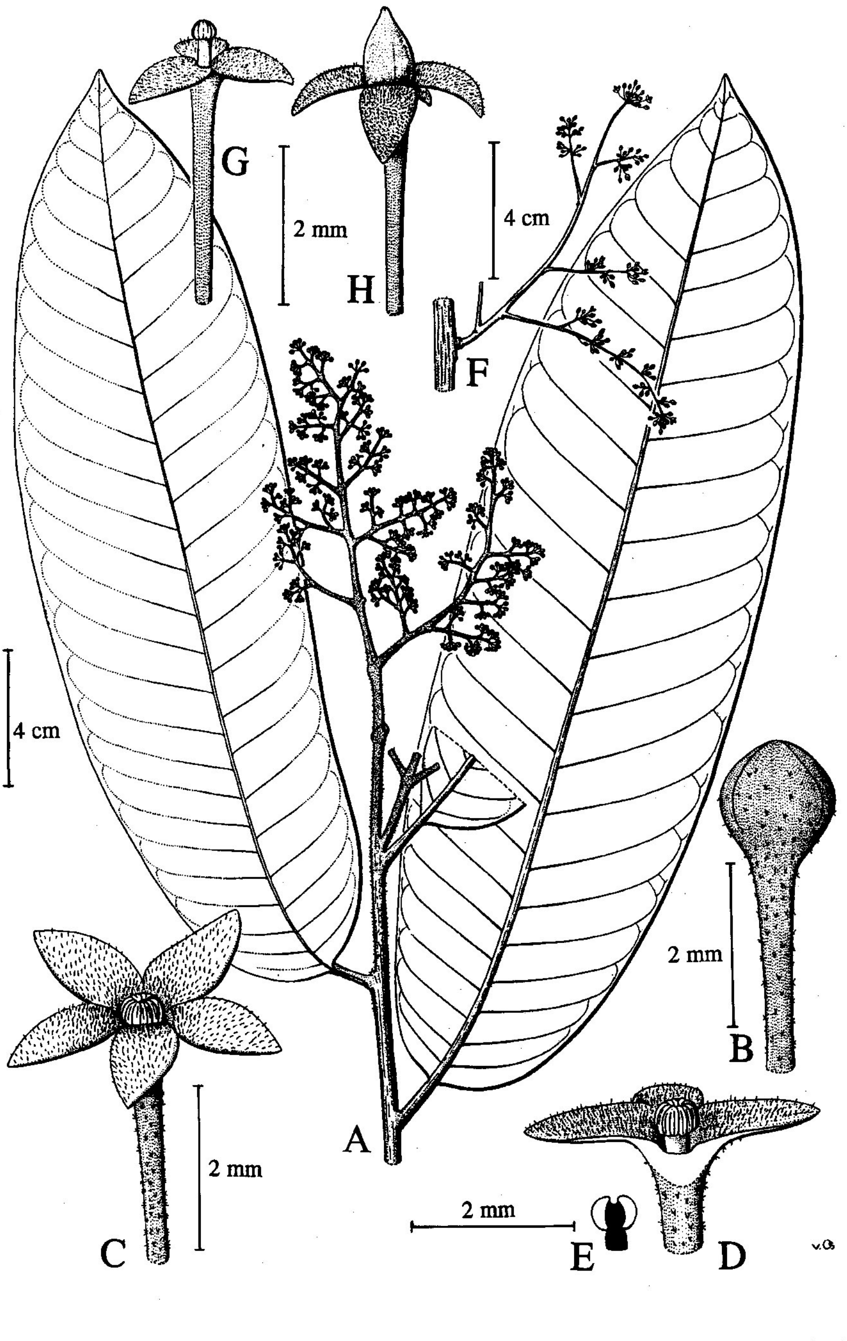

Fig. 1. *Endocomia rufirachis* (A–E); *E. macrocoma* subsp. *longipes* (F–H). A, flowering leafy twig, with all flowers in about the same stage of development; B, mature male flower bud; C, male flower at anthesis; D, section of male flower; E, schematic longitudinal section of androecium with the androphore and central column drawn in solid black; F, inflorescence with female and male flowers in different stages of development; G, male flower at anthesis; H, female flower at anthesis. (A–E from *BNB For. Dept. 1716*, F–H from *SAN 66753*.)

part striate, tending to be flaky, lenticels inconspicuous. *Terminal leaf buds* 8–12 mm long, *rusty pubescent with hairs 0.3–0.5 mm long*. **Leaves** membranous or thinly chartaceous, upper surface drying brown, glabrous, lower surface early glabrescent; elliptic to lanceolate, 18–38 × 6–11 cm, base subcordate or rounded or short-cuneate, apex acute-acuminate; midrib glabrescent on both surfaces, flattish or moderately raised above; lateral veins 17–25(–30) pairs, partly raised above, interarching connection often distinct and regular; intercostal venation distinct or faint above; petiole 0.8–2.5 cm long, glabrescent. **Inflorescences** *rusty pubescent with hairs 0.5–0.7 mm long*, 3–5-times branched, many-flowered, 8–30 × 5–25 cm; peduncle 1.5–5 cm long; bract 2–6 mm long, caducous. **Male flowers** in dense clusters of 5–10, sometimes in lax clusters of 2 or 3 only; *all flowers of one cluster in the same stage of development*; pedicel slender, 2–3.5 mm long; buds ovoid to more or less obconical, 1.5–1.8 × 1.2–1.5 mm, apex rounded to subtruncate; *perianth (3–)4–5-lobed*, pubescent with hairs 0.2–0.5 mm long outside, late-glabrescent, lobes inside rusty pubescent with similar hairs arranged in few longitudinal rows, at anthesis clefts to 3/4–4/5, the lobes spreading or more or less recurved, *c*. 0.2 mm thick; *synandrium depressed globose*, (0.2–)0.3 × 0.5–0.6 mm; *anthers 4*; *androphore much shorter than the synandrium*, *c*. 0.3 × 0.2–0.3 mm. **Female flowers** not seen. **Infructescences** large panicles up to 30 cm long, bearing 6–18 fruits. **Fruits** ellipsoid-oblong, glabrous, apex narrowly rounded, base subacute or often tapering into a 4–10 mm long narrow portion, 4.5–6.5 × 1.8–2.5 cm, glabrous, drying blackish, finely granulate, without lenticels, not warted; dry pericarp 1.5–3(–4) mm thick; stalk 0.8–1.6 cm long. **Seeds** 3.5–4.5 cm long, apex with a beak 0.2–4 mm long; aril laciniate at apex to 1/5–1/3.

Vernacular name. Sabah—*sikut nabalu* (Dusun).

Distribution. Endemic to Borneo (Sabah, Sarawak and E Kalimantan).

Ecology. In primary and logged-over lowland rain forests on flat lands and hill slopes, up to 400 m altitude; on leached clays, loam soils, black soils, also on sandstone and limestone or on periodically inundated ground. Flowering and fruiting throughout the year.

3. **Endocomia virella** W.J. de Wilde

(Latin, *virellus* = greenish; the drying leaves)

Blumea 30 (1984) 194; Whitmore, Tantra & Sutisna *l.c.* 262; Coode *et al.* (eds.) *l.c.* 220. **Type:** *Sadau SAN 49546*, Borneo, Sabah (holotype L; isotypes K, SAN).

Tree up to 20 m tall. **Bark** greenish, brown-yellow, yellowish green or black, smooth or scaly; inner bark either reddish, orange-yellow, or brownish; sap clear or red. **Sapwood** white, soft or medium-hard. **Twigs** towards apex 1.5–4 mm diameter, *apex initially grey-brown tomentose with hairs up to 0.1 mm long*, *early glabrescent*; lower part faintly longitudinally cracked, not flaky, lenticels absent. *Terminal leaf buds* 6–10 × 0.6–1 mm, *sparsely pubescent with hairs up to 0.1 mm long*, *early glabrescent*. **Leaves** membranous or thinly chartaceous, *upper surface drying olivaceous*, glabrous, lower surface pale green, glabrous; elliptic to oblong, *8–20 × 3.5–8 cm*, base cuneate, apex acute-acuminate; midrib flat above; *lateral veins 7–12 pairs*, flat or slightly raised above, interarching connection distinct or not; intercostal venation indistinct on both surfaces; petiole slender, glabrous, 1–1.8 cm long. **Inflorescences** *lax*, *initially sparsely tomentose with minute hairs less than 0.1 mm long*, *early glabrescent* or glabrous, 5–15 × 1.5–8(–10) cm; peduncle 0.5–2.5 cm long; bract caducous. **Male flowers** in widely spaced, lax, umbel-like clusters of 2–6, *those in one cluster usually in different stages of development*; pedicel slender, 4–6 mm long; buds broadly ellipsoid or broadly ovoid, 1.8–2 × 1.5–1.6 mm, apex rounded or subacute, base broadly rounded, in cross-section more or less 3(–4)-angular; *perianth 3–4-lobed*, outside at first with sparse tomentum of hairs less than 0.1 mm long, early glabrescent; lobes inside towards the apex pubescent with pale hairs 0.2–0.4 mm long arranged in a few rows corresponding with the spaces in between the anthers, at anthesis clefts to *c*. 5/6, lobes spreading or more or less recurved, *c*. 0.2 mm thick; *synandrium depressed globose*, *0.2–0.3 × 0.3–0.4 mm*; *anthers 3 or 4*; *androphore slender, 0.8–1 × 0.2 mm*. **Female flowers** not seen. **Infructescences** little-branched panicles, 12–25 cm long, bearing 1–4 fruits. **Fruits** ellipsoid-obovoid to ellipsoid-oblong, *(4.5–)5–7 × 2.5–3.5 cm*, apex rounded, base subattenuate or with a narrowed portion up to 7 mm long, glabrous, finely granulate; *pericarp* more or less woody, *5–8 mm thick*, *drying bright dark brown*; stalk 2.5–3 cm long. **Seeds** *c*. 4 cm long, apex subacute; aril laciniate to 1/4–1/3.

Distribution. Endemic to Borneo (Sabah and Sarawak).

Ecology. In primary forest on hill sides and ridges, up to 400 m altitude, on brown or blackish soils. Flowering in January and May; fruiting in January, August and October.

2. **GYMNACRANTHERA** (A. DC.) Warb.

(Greek, *gymnos* = naked; *acron* = top; *anthera* = anther)

penarahan (preferred name), *darah-darah* (Malay), *kumpang* (Iban)

Ber. Pharm. Ges. 2 (1892) 227; Monogr. Myrist. (1897) 131; Gamble, J. As. Soc. Beng. 75, 2 (1912) 222; Ridley, FMP 3 (1924) 61; J. Sinclair, Gard. Bull. Sing. 16 (1958) 434, *ibid*. 17 (1958) 96; Whitmore, TFM 1 (1972) 318; Anderson, CLTS (1980) 263; Schouten, Blumea 31(1986) 451; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 262; PROSEA 5, 2 (1995) 255; Coode *et al.* (eds.), CLBD (1996) 221; Argent *et al.* (eds.), MNDT-CK 2 (1997) 445. **Basionym:** *Myristica* sect. *Gymnacranthera* A. DC., Ann. Sc. Nat. 4, 4 (1855) 31.

Dioecious trees or shrubs. **Twigs** terete or bluntly angular, appressed hairy, usually glabrescent; *bark smooth*, when older finely cracked, *never distinctly striate*, always lenticellate but sometimes inconspicuously so. **Leaves** *distichous*, membranous, chartaceous or coriaceous, rather tough when dry, lower surface often glaucous, glabrescent or with persistent tomentum of usually rather remote, appressed, inconspicuous hairs (tomentum more or less persistent in *G. bancana*); lateral veins more or less flat above, flat to prominent beneath; intercostal venation usually more or less indistinct on both surfaces. **Inflorescences** axillary, rarely on the older branches, *paniculate*, glabrescent or pubescent to various degree; *at base of peduncle with few scars of minute cataphylls*; bract small, caducous; *males usually several times branched at or near the base*; females condensed, few-flowered.

Flowers pedicelled, pubescent to various degree, more or less solitary (in females) or in loose clusters; all flowers in one inflorescence usually in about the same stage of development; *pedicel at base not articulated*; *bracteole absent*; *perianth* thinly coriaceous, (2–)3–4-lobed, *thinly appressed pubescent on both sides*, outside yellow, inside never red, *lobes* of various depth, in females deeper than in males, *at anthesis in males erect* or slightly spreading, *in females spreading or more or less reflexed*. **Male flowers:** buds ellipsoid or ellipsoid-oblong; androecium markedly uniform in all species, about as long as the perianth tube (shorter in *G. bancana*); *synandrium more or less cylindrical-ellipsoid*, *sessile or on a short narrow stalk (androphore)*; *anthers* 5–12, *laterally tightly connate and for most of their backsides adnate to the central column*, separated by deep clefts, *apices free*, more or less erect or somewhat curved inward; *central column with excavation at the top*, narrow, about as wide or narrower than the androphore. **Female flowers:** buds smaller and usually wider than the males, ovoid or pyriform; pedicel shorter; ovary subglobose or broadly ovoid, short-pubescent, stigma small, obliquely 2-lobed and each lobe usually minutely 3–6-lobulate. **Infructescences** *paniculate*, *few-branched from near the base*, *with scars of cataphylls at the base*. **Fruits** subglobose to ellipsoid, *1.5–3.5 cm long*; pericarp fleshy but hard, drying brownish, short-pubescent or glabrescent; perianth not persistent. **Seeds** ellipsoid; aril completely covering the seed, *deeply laciniate to near the base* (as in *Myristica*); endosperm containing a fixed oil but no starch.

Distribution. Seven species, ranging from S India to S Thailand, Sumatra, Peninsular Malaysia, Borneo, and eastwards to New Guinea and Bismarck Archipelago; not known from Palawan, Java and the Lesser Sunda Islands. In Sabah and Sarawak represented by 5 species.

Ecology. Scattered and frequent understorey trees in well-drained, primary and secondary mixed dipterocarp forests, at altitude up to 1300 m. In peatswamp and *kerangas* forest they constitute elements of the main canopy layer.

Key to *Gymnacranthera* species

1. Male flowers 4–6 mm long; androecium much smaller than the perianth, and shorter than the perianth tube. Tomentum of young twig and inflorescence composed of woolly hairs (0.5–)1(–2) mm long. Lower leaf surface pubescent with woolly hairs *c.* 0.5 mm long. Leaves 18–42 cm long; petiole 0.3–0.5 cm thick. Fruits 2.5–3.5 cm long, pubescent with hairs 0.3(–0.5) mm long........…………..........……………....**1. G. bancana**
   Male flowers 2–5 mm long; androecium relatively longer, about as long as the perianth tube. Tomentum of young twig and inflorescence less conspicuous, glabrescent or composed of hairs up to 0.5 mm long. Lower leaf surface glabrescent or with appressed hairs less than 0.5 mm long. Leaves of various sizes; petiole 0.1–0.3 cm thick. Fruits generally smaller, glabrescent.....……………………....................……………………2

2. Young twig, including the apical portion, conspicuously densely set with distinct lenticels. Lower leaf surface pubescent with distinct, usually brown hairs; midrib flat above. Lateral veins forming an angle of *c.* 45° with the midrib. Fruits ovoid-ellipsoid, short-pubescent, *c.* 2 cm long, with truncate base…………….....……...**5. G. ocellata**
   Twig towards apex without or with fewer lenticels. Lower leaf surface glabrescent

or with scattered, inconspicuous, usually greyish or pale brown hairs; midrib flat or sunken above. Lateral veins generally forming an angle of more than 45º with the midrib. Fruits globose or ellipsoid-oblong, glabrescent or pubescent, of various sizes, base not truncate........……………………………………….................……………..3

3. Twig usually slender, towards apex 1–2 mm diameter, about 10 cm lower down 2–3.5 mm diameter. Leaves 5–20 × 1.5–5.5(–6) cm; midrib flat or sunken above..........…
……………………………………………………………...………...…**3. G. farquhariana**
Twig stout, towards apex (2–)2.5–4(–5) mm diameter, about 10 cm lower down (3–) 3.5–5.5 mm diameter. Leaves 14–33 × (5.5–)6–13 cm; midrib usually sunken above………………………………………..............…………………………….4

4. Lateral veins on lower leaf surface distinct but only slightly prominent, at an angle of 60–70° with the midrib in the middle of the leaf. Leaves drying flat, not undulate. Anthers 6(–8), straight……………………………...............…………..**2. G. contracta**
Lateral veins on lower leaf surface very distinct and prominent, at an angle of (35–) 40–50(–55)° with the midrib in the middle of the leaf. Leaves generally drying irregularly undulate, not flat. Anthers 6–10, sometimes twisted.......…......**4. G. forbesii**

1. **Gymnacranthera bancana** (Miq.) J. Sinclair Fig. 2A–F.

(of Bangka, Sumatra)

Gard. Bull. Sing. 16 (1958) 436, *l.c.* 17 (1958) 99; Schouten *l.c.* 463; Whitmore *l.c.* 319; Anderson *l.c.* 263; Whitmore, Tantra & Sutisna *l.c.* 262; Turner, Gard. Bull. Sing. 47 (1995) 357; Coode *et al.* (eds.) *l.c.* 221. **Basionym:** *Myristica bancana* Miq., Fl. Ind. Bat., Suppl. 1 (1861) 383. **Type:** *Teijsmann 3279*, Sumatra, Bangka (U). **Synonyms:** *M. murtonii* Hook. *f.*, Fl. Brit. Ind. 5 (1886) 105; *G. murtonii* (Hook. *f.*) Warb. *l.c.* (1897) 357; *M. ferruginea* Wall. *ex* King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 298; *M. amplifolia* Warb. *l.c.* (1897) 517; *G. murtonii* (Hook. *f.*) Warb. var. *borneensis* Warb. *l.c.* (1897) 359; *M. murtonii* Hook. *f.* var *borneensis* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 88; *G. bancana* (Miq.) J. Sinclair var. *borneensis* (Warb.) J. Sinclair *l.c.* 16 (1958) 439.

Tree up to 40 m tall; crown dense or spreading; bole smooth; buttresses absent. **Bark** brown to grey, slightly fissured, finely or thickly flaky. **Twigs** stout, faintly angular, towards apex 3–6 mm diameter, *when young rusty brown tomentose with woolly hairs (0.5–)1(–2) mm long*; bark of lower part smooth or finely cracked, densely set with lenticels. Terminal leaf buds 10–20 mm long, pubescent with rusty hairs 0.5–1 mm long. **Leaves** *coriaceous*, upper surface drying olivaceous, often shining, *lower surface densely rusty tomentose with woolly hairs c. 0.5 mm long*, glabrescent, grey-brown; elliptic to lanceolate, *18–42 × 7.5–19 cm*, base attenuate to rounded or subcordate, margin often revolute, apex acute-acuminate, acumen up to 1.5 cm long; midrib flat above; lateral veins (13–)15–23 pairs, flat or slightly raised above, very prominent beneath; intercostal venation indistinct on both surfaces; *petiole* late-glabrescent, 1–2 cm long, *0.3–0.5 cm thick*. **Inflorescences** *pubescent with rusty woolly hairs 1–2 mm long*; bract 2–4 mm long, caducous; males 6–10 cm long, many-flowered; females 2–5 cm long, few-flowered. **Flowers** rusty pubescent on both sides with hairs 0.2–0.3 mm long. **Male flowers:** *buds ellipsoid-oblong*, *4–6 mm long*; perianth 3(–4)-lobed, at anthesis clefts to *c.* 1/4 to nearly halfway, tube 2.5–3.5 mm long; *androecium* truncately ellipsoid, subsessile, *shorter than the perianth tube*,

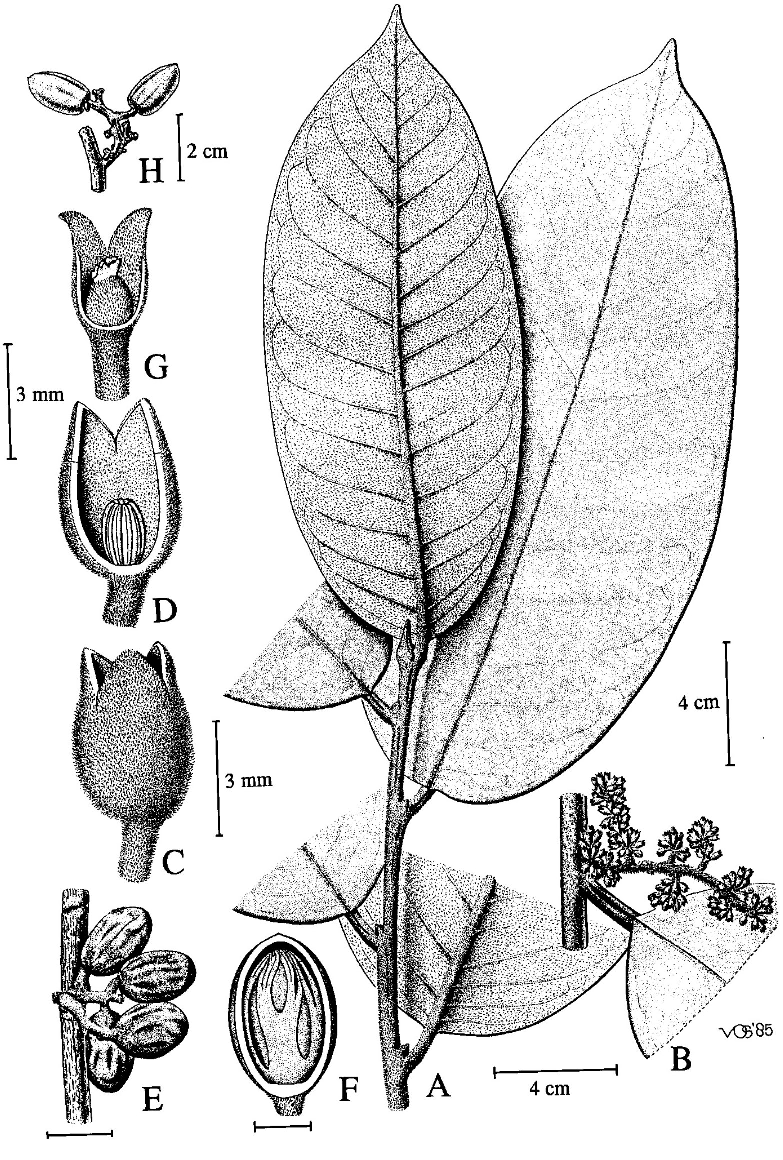

Fig. 2. *Gymnacranthera bancana* (A–F); *G. ocellata* (G–H). A, leafy twig; B, male inflorescence; C, male flower; D, sectioned male flower; E, infructescence; F, sectioned fruit showing thin pericarp and deeply laciniate aril; G, sectioned female flower; H, fruits with truncate base. (A from *Sinclair SFN 39502*, B–D from *Sinclair SFN 40045*, E–F from *Sinclair & Kadim 10436*, G from *Endert 4835*, H from *Ilias S. 39255*.)

1.5–2 mm long; anthers (7–)9–10, free apices minute, more or less erect. **Female flowers:** pedicel (known from immature flowers) *c.* 1 mm long; buds ovoid, 4–6 mm long; perianth coriaceous, 3-lobed; ovary subglobose, densely pubescent. **Fruits** 2–8 per infructescence, ellipsoid, *2.5–3.5 × 1.5–2.2 cm*, *rusty pubescent with hairs c. 0.3(–0.5) mm long*; pericarp *c.* 3 mm thick; stalk 0.3–0.5 cm long.

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sarawak and Brunei).

Ecology. In primary and secondary well-drained forests, on hill sides and ridges, up to 250 m altitude, also in swamp forest, on granite rock, sand and sandy loam soils. Flowering in September–October; fruiting throughout the year.

2. **Gymnacranthera contracta** Warb.

(Latin, *contractus* = contracted; the condensed inflorescences)

Monogr. Myrist. (1897) 360; Merrill, EB (1921) 269; Masamune, EPB (1942) 300; J. Sinclair *l.c.* 16 (1958) 439, *l.c.* 17 (1958) 100, *p.p.*; Whitmore *l.c.* 320 (*excl.* Malayan specimens); Anderson *l.c.* 263; Schouten *l.c.* 471; Whitmore, Tantra & Sutisna *l.c.* 262; Coode *et al.* (eds.) *l.c.* 221; Argent *et al.* (eds.) *l.c.* 446. **Synonyms:** *Myristica contracta* (Warb.) Boerl. *l.c.* 88. **Type:** *Beccari 321*, Borneo, Sarawak (holotype K; isotypes BO, C, FI, G, M, NY, P, S).

Tree up to 26 m tall. **Bark** reddish brown, nearly smooth, very finely scaly; inner bark hard, pale reddish brown. **Twigs** *stout*, subterete to angular or more or less ridged, *towards apex 3–4(–5) mm diameter*, *at first tomentose with very minute hairs up to 0.5 mm long*, *glabrescent*; bark chocolate to greyish brown, smooth, finely longitudinally cracked, *with lenticels when older*. Terminal leaf buds 4–8 mm long, sometimes with additional cataphylls (scales), minutely appressed pubescent. **Leaves** chartaceous to subcoriaceous, *drying flat and not undulate*, upper surface drying brownish, often shining, *lower surface pubescent with scattered appressed hairs less than 0.5 mm long*, *glabrescent*, *greyish to pale brown*; oblong to lanceolate, more or less parallel-sided, *(16–)20–29 × 6–9.5 cm*, base short-attenuate to rounded, margin plane, apex acute-acuminate, acumen up to 2 cm long; *midrib slightly sunken above*, narrow; *lateral veins* (11–)13–18 pairs, flat above, *distinct but not much prominent beneath*, *at an angle of 60–70° with the midrib in the middle of the leaf*; intercostal venation indistinct on both surfaces; *petiole* 1–2(–2.5) cm long, *0.1–0.3 cm thick.* **Inflorescences** *pubescent with rusty hairs 0.3–0.5 mm long*; bract *c.* 2.5 × 3 mm, pubescent, caducous; males condensed panicles, 3.5–4.5 cm long; females contracted, 1.5–2 cm long, fewer but more densely flowered. **Flowers** rusty pubescent on both sides, hairs 0.1–0.2 mm long. **Male flowers:** pedicel 2–2.5 mm long; *buds* ellipsoid-oblong, *2.5–2.8 mm long*; perianth 3–4-lobed, at anthesis clefts to 1/3 to nearly 2/3, tube 1–1.8 mm long; *androecium* more or less truncately ellipsoid-oblong, *c. 1.7 mm long* (i.e. *about as long as the perianth tube*), subsessile; *anthers 6(–8)*, the free apices minute, *more or less erect*. **Female flowers:** pedicel 1–2 mm long; buds narrowly obovoid, 3–3.5 mm long; ovary subglobose, pubescent, *c.* 1.2 mm diameter. **Fruits** *c.* 7 per infructescence, *ellipsoid-oblong*, *2–2.2 × 1–1.4 cm*, *pubescent with hairs c. 0.1 mm long or early glabrescent*, *base not truncate*; pericarp 1.2–1.4 mm thick; stalk 0.3–0.7 cm long.

Vernacular name. Sabah—*lanau* (preferred name).

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and possibly W Kalimantan).

Ecology. In primary lowland forest, up to 600 m altitude. Flowering in July–September; fruiting in October–December.

3. **Gymnacranthera farquhariana** (Hook. *f.* & Thomson) Warb.

(W. Farquhar, 1770–1839, major in the British Army, the first colonial resident of Singapore)

Monogr. Myrist. (1897) 365; Gamble *l.c.* 225; Ridley *l.c.* 62; Schouten *l.c.* 476; Whitmore, Tantra & Sutisna *l.c.* 262; Turner *l.c.* 357; Coode *et al.* (eds.) *l.c.* 221; Argent *et al.* (eds.) *l.c.* 446. **Basionym:** *Myristica farquhariana* Wall. *ex* Hook. *f.* & Thomson, Fl. Ind. (1855) 161, *p.p.* **Lectotype** (Schouten, 1986)**:** *Wallich Cat. 6795*, Singapore (K).

Tree up to 45 m tall; crown dense. **Bark** brown or grey, slightly fissured and finely flaky or scaly; inner bark dark brown, 4–15 mm thick. **Sapwood** white to yellow; heartwood yellow to brown, hard. **Twigs** subterete, *slender*, *towards apex 1–2 mm diameter*, *at first tomentose with minute hairs c. 0.1 mm long*, *early glabrescent*; *bark* later on grey-brown, smooth, *lenticellate*. Terminal leaf buds 5–10 mm long, pubescent with appressed greyish hairs *c.* 0.1 mm long. **Leaves** chartaceous to coriaceous, upper surface drying olivaceous or chocolate, sometimes shining, *lower surface at first thinly tomentose with appressed hairs c. 0.1 mm long*, *glabrescent*, *pale brown* to grey-purplish; elliptic to lanceolate, *5–20 × 1.5–6 cm*, base more or less attenuate, margin conspicuously revolute or not, apex acute-acuminate, acumen up to 2 cm long; *midrib flat or sunken above*; *lateral veins* 7–11(–15) pairs, *at an angle of more than 45º with the midrib*, flat or raised beneath, distinct and contrasting in colour with the lower leaf surface or not; intercostal venation generally indistinct; *petiole* 0.6–1.5 cm long, *0.1–0.3 cm thick*. **Inflorescences** paniculate, *pubescent with hairs c. 0.2 mm long*; bract *c.* 1 mm long, caducous; *males* 2.5–12 cm long, many-flowered; females up to 4 cm, few-flowered. **Flowers** rusty pubescent with hairs *c.* 0.1 mm long on both sides. **Male flowers:** pedicel 1.5–4 mm long; *buds* ellipsoid to ellipsoid-oblong, *2.5–4 mm long*; perianth 3–4-lobed, at anthesis clefts to 1/3–2/3, tube 1–2.3 mm long; *androecium* more or less truncately ellipsoid-oblong, *1–2.5 mm long*, subsessile; anthers (6–)7–11(–13), free apices up to 0.5 mm long, more or less erect or somewhat incurved. **Female flowers:** pedicel 1.5–3 mm long; buds ovoid or obpyriform, 2–3 mm long; ovary minutely pubescent, *c.* 1 mm diameter, stigma minute. **Fruits** up to 13 per infructescence, *subglobose or ellipsoid-oblong*, *1.8–2.8 × 1.1–1.9 cm*, *base not truncate*, *glabrescent* (glabrous) *or inconspicuously pubescent with hairs c. 0.1 mm long*; pericarp *c.* 1 mm thick; stalk 0.4–1.5 cm long.

Vernacular name. Sarawak—*kumpang putih* (Iban).

Distribution. A widespread and variable species, ranging from Peninsular Malaysia through Malesia to the Bismarck Archipelago. Three closely related varieties occur in Sabah and Sarawak.

Key to varieties

1. Leaves oblong-lanceolate, 5–13.5 × 1.5–4.5 cm; lateral veins not or hardly raised beneath..

var. **eugeniifolia** (A. DC.) R.T.A. Schouten

(with leaves resembling that of *Eugenia*, Myrtaceae)

l.c. 480; Turner *l.c.* 357; Coode *et al.* (eds.) *l.c.* 221. Basionym: *Myristica eugeniifolia* A. DC., Ann. Sc. Nat. 4, 4 (1855) 29. Type: *Gaudichaud 116*, Peninsular Malaysia, Penang (FI, G, P). Synonyms: *G. apiculata* Warb. *l.c.* (1897) 359; *M. apiculata* (Warb.) Boerl. *l.c.* 88; *G. eugeniifolia* (A. DC.) J. Sinclair *l.c.* 16 (1958) 444, *p.p.*; Whitmore *l.c.* 320; *G. eugeniifolia* A. DC. var. *eugeniifolia*: J. Sinclair *l.c.* 16 (1958) 444, *p.p.*, *l.c.* 17 (1958) 112, *p.p.*

Tree up to 30 m tall. Leaves chartaceous to coriaceous, widest at or below the middle, margin little or conspicuously revolute or not; lateral veins 6–10 pairs; petiole 0.7–1.4 cm long, 0.1–0.15 cm thick. Fruits 1–3(–5) per infructescence, 1.8–2.2 × 1.3–1.8 cm; stalk 0.4–1.3 cm long.

Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak). In primary and degraded forests, on hill sides and ridges as well as in periodically inundated places, near streams and rivers, and in *kerangas* forest, also found on limestone and sandy soils, up to 1300 m altitude. Flowering mainly in March–October; fruiting in July–February.

Leaves elliptic, elliptic-oblong to lanceolate, 6–20 × 2–8.5 cm; lateral veins usually clearly visible and contrasting, usually distinctly raised beneath......................2

2. Leaves coriaceous, elliptic to elliptic-oblong, 6–15(–17) × 3–5.5(–6) cm, margin conspicuously revolute. Fruits short-ellipsoid to globose.....................................

var. **farquhariana**

Turner *l.c.* 358; Coode *et al.* (eds.) *l.c.* 221. Synonyms: *G. farquhariana* (Hook. *f.* & Thomson) Warb. var. *griffithii* (Hook. *f.*) Warb. *l.c.* (1897) 368; *G. eugeniifolia* (A. DC.) J. Sinclair var. *griffithii* (Hook. *f.*) J. Sinclair *l.c.* 17 (1958) 113, Whitmore *l.c.* 320; *Myristica farquhariana* Hook. *f.* & Thomson var. *major* King, *l.c.* 306; *G. farquhariana* (Hook. *f.* & Thomson) Warb. var. *major* (King) Gamble *l.c.* 226.

Tree up to 30 m tall, occasionally with stilt roots. Leaves widest at or above the middle; lateral veins 7–11 pairs; petiole 0.8–1.8 cm long, 0.15–0.2 cm thick. Fruits 1–6 per infructescence, globose to short-ellipsoid; stalk 0.6–1.5 cm long.

Peninsular Thailand, Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah and Sarawak). In primary and degraded forests, mostly in peatswamp forest but occasionally also found on hill sides, up to 1000 m altitude. Flowering mainly in April–July; fruiting in September–March.

Leaves membranous, chartaceous or sometimes coriaceous, elliptic-oblong to lanceolate, 8–20 × 2–6 cm, margin plane, rarely revolute. Fruits ellipsoid to oblong..............................

var. **zippeliana** (Miq.) R.T.A. Schouten

(A. Zippelius, 1797–1828, horticulturist, sometime assistant curator of the Bogor Botanic Gardens)

l.c. 482; Turner *l.c.* 358. Basionym: *Myristica zippeliana* Miq. *l.c.* 2 (1865) 50. Type: *Zippelius s.n.*, New Guinea, Vogelkop (L). Synonyms: *G. zippeliana* (Miq.) Warb. *l.c.* (1897) 373; *G. paniculata* (A. DC.) Warb. var. *zippeliana* (Miq.) J. Sinclair *l.c.* 17 (1958) 108; *G. suluensis* Warb. *l.c.* (1897) 373.

Tree up to 45 m tall. Leaves widest at or above the middle; lateral veins 8–11(–15) pairs, pale yellowish and little contrasting in colour; petiole 0.7–1.5 cm long, 0.1–0.2 cm thick. Fruits (1–)2–13 per infructescence, (1.5–)1.8–2.5 × 1.1–1.5 cm; stalk 0.4–0.8 cm long.

Sumatra, Peninsular Malaysia, Singapore, Borneo (Sabah and Sarawak), the Philippines, Sulawesi, Maluku, and New Guinea. In primary and degraded forests, mostly on hill sides and ridges, on sandstone, clay, and loam, and granite rock, up to 900 m altitude. In Borneo, all records from 400–1200 m. Locally abundant, frequently mentioned as part of regenerating forest. Flowering mainly in July–November; fruiting in March–May and October–November.

4. **Gymnacranthera forbesii** (King) Warb.

(H.O. Forbes, 1851–1932, Scottish botanist)

Monogr. Myrist. (1897) 363; Gamble *l.c.* 224; Ridley *l.c.* 61; J. Sinclair *l.c.* 16 (1958) 441, *l.c.* 17 (1958) 101; Whitmore *l.c.* 320; Anderson *l.c.* 263; Schouten *l.c.* 472; Turner *l.c.* 358; Argent *et al.* (eds.) *l.c.* 446. **Basionym:** *Myristica forbesii* King *l.c.* 306. **Lectotype** (Schouten, 1986)**:** *Forbes 2976*, Sumatra (hololectotype K; isolectotypes BM, L).

Tree up to 35 m tall. **Bark** grey-brown, smooth or finely fissured or sometimes flaky; inner bark pink to red-brown, laminated, sometimes fibrous. **Sapwood** white, pale yellow to orange-brown. **Twigs** *stout*, subterete, *towards apex (2–)2.4–4 mm diameter*, *without or with a few lenticels*, *early glabrescent*, *rarely with sparse pubescence comprising hairs up to 0.1 mm long on young twigs*; bark later on brown or grey, finely cracked, with many lenticels. Terminal leaf buds 5–10 mm long, greyish tomentose with hairs *c.* 0.1 mm long. **Leaves** chartaceous or coriaceous, *upper surface drying often coarsely undulate* (not flat), olivaceous brown, sometimes shining, *lower surface at first tomentose with scattered appressed minute hairs less than 0.5 mm long*, *glabrescent*, *grey-brown*; elliptic to lanceolate, *14–33 × (5.5–)6–13 cm*, base attenuate to broadly rounded, margin plane, apex acute-acuminate, acumen up to 1 cm long; *midrib sunken above*; *lateral veins* 10–18 pairs, flat above, yellowish, *very prominent beneath*, *at an angle of (35–)40–50 (–55)° with the midrib in the middle of the leaf*; intercostal venation sometimes distinct on the lower surface; *petiole* 0.8–2 cm long, *0.1–0.3 cm thick*. **Inflorescences** paniculate, *pubescent with grey-rusty woolly hairs 0.2–0.4 mm long*; bract *c.* 3 mm long, caducous; males 4–12 cm long, many-flowered; females 1–4 cm long, generally few-flowered. **Flowers** grey-rusty pubescent on both sides with hairs 0.1–0.2 mm long. **Male flowers:** pedicel 2–3 mm long; buds ellipsoid-oblong, *2.5–4 mm long*; perianth 3(–4)-lobed, at anthesis clefts to *c.* 1/3 to nearly halfway, tube 1.5–2.3 mm long; *androecium* more or less truncately ellipsoid-oblong, subsessile, *1.5–2.3 mm long*; *anthers 6–10*, *often somewhat twisted*, free apices 0.3–0.5 mm long, more or less erect. **Female flowers:** pedicel *c.* 2 mm long; buds ovoid or pyriform, 2–2.5 mm long; ovary 1–1.3 mm diameter, minutely pubescent; stigma minutely 2-lobed. **Fruits** 4–25 per infructescence, *ellipsoid-oblong*, *1.8–2.4 × 1–1.4 cm*, *base not truncate*, *glabrescent or short-pubescent with hairs c. 0.1 mm long*; pericarp *c.* 1 mm thick; stalk 0.4–1 cm long.

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Singapore, and Borneo.

Key to varieties

Leaves thickly coriaceous; lateral veins on lower surface prominent and thick, on the average 0.5–0.7 mm wide. Infructescences conspicuously branched from the base, many-fruited..

var. **crassinervis** (Warb.) J. Sinclair

(Latin, *crassinervis* = prominently veined; the leaf undersurface)

l.c. 17 (1958), 102; Schouten *l.c.* 475. Basionym: *G. crassinervis* Warb. *l.c.* (1897) 362. Lectotype: *Beccari 1119*, Borneo, Sarawak (K). Synonym: *Myristica crassinervis* (Warb.) Boerl. *l.c.* 88.

Leaves elliptic-oblong to oblong-lanceolate, 16–33 × 6–12 cm. Infructescence bearing 8–25 fruits.

Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan). In primary and degraded well-drained as well as swampy forests, on sandy, sandy-clay, and loamy soils, up to 1250 m altitude. Flowering mainly in April and August; fruiting in April and August–December.

Leaves chartaceous to coriaceous; lateral veins on lower surface moderately prominent, 0.3–0.5 mm wide. Infructescences usually not much branched at the base, few-fruited............... var. **forbesii**

J. Sinclair *l.c.* 17 (1958), 101; Schouten *l.c.* 474; Coode *et al.* (eds.) *l.c.* 221.

Leaves elliptic to oblong, 14–28 × (5.5–)6–13 cm. Infructescences bearing 4–10 fruits.

S Thailand (Pattani), Sumatra, Peninsular Malaysia, Singapore, and Borneo (several collections from Sabah and Sarawak). In primary and secondary forests on hill sides and riverine alluvial forest, on sandy and limestone- as well as sandstone-derived soils, up to 600 m altitude. Flowering in February–April and August–September; fruiting in May–August and December–January.

Vernacular names. Sarawak—*darah-darah* (Malay), *kumpang* (Bidayuh), *lahu* (Kayan).

5. **Gymnacranthera ocellata** R.T.A. Schouten Fig. 2G–H.

(Latin, *ocellus* = a little eye; the many lenticels on the twigs)

Blumea 31 (1986) 469; Coode *et al.* (eds.) *l.c.* 221; Argent *et al.* (eds.) *l.c.* 446. **Type:** *Saikeh SAN 72177*, Borneo, Sabah, Beaufort Hill (holotype L; isotypes K, KEP, SAN, SAR, SING).

Tree up to 25 m tall. **Bark** smooth or fissured or regularly cracked, sometimes flaky, grey to dark red-brown; inner bark 10–15 mm thick, brown. **Sapwood** whitish streaked with pale red; heartwood light brown to blackish brown. **Twigs** usually angular or compressed, stout, towards apex 2–3.5(–5) mm diameter, *tomentose with appressed hairs c. 0.2 mm long*, *glabrescent*; *bark* usually grey, smooth or finely cracked, *including that of apical portion of the twig densely set with conspicuous lenticels of mixed sizes*; at base of each seasonal shoot with distinct scars of cataphylls of bud scales. Terminal leaf buds rather stout, *c.* 10 × 3 mm, densely appressed pubescent. **Leaves** chartaceous or thinly coriaceous, upper surface drying olivaceous, often shining, *lower surface with distinct more or less spaced appressed rusty brown hairs less than 0.5 mm long*, *glabrescent*, grey-brown; ovate-elliptic to lanceolate, *10–25 × 4–9.5 cm*, base short-attenuate to broadly rounded, margin plane, apex acute; *midrib flat above*; *lateral veins* 11–18 pairs, flat to slightly raised above, distinct but not prominent beneath, *at an angle of c. 45° with the midrib in the middle of the leaf*; intercostal venation indistinct on both surfaces; *petiole* 0.9–1.8 cm long, *0.2–0.3 cm thick*. **Inflorescences** broadly paniculate, *pubescent with rusty hairs 0.3–0.5 mm long*; bract *c.* 2.5 × 3 mm, caducous; males 3–8.5 cm long, many-flowered; females up to 2 cm long, few-flowered. **Flowers** rusty pubescent on both sides with hairs 0.1(–0.2) mm long. **Male flowers:** pedicel 1.5–3.5 mm long; *buds* ellipsoid-oblong, *3–4(–5) mm long*; perianth 3–4-lobed, at anthesis clefts to 1/3–1/2, tube 2–2.5 mm long; *androecium* more or less truncately ellipsoid, subsessile, *1.5–2.3 mm long*; anthers

7–10, the free apices 0.4–0.5 mm long, more or less erect. **Female flowers:** pedicel 1.5–2.5 mm long; buds narrowly ovoid, 2.7–3 mm long; ovary 1.2–1.5 mm diameter, minutely pubescent, stigma shallowly 2-lobed. **Fruits** 4–10 per infructescence, *ovoid-ellipsoid with truncate base*, *1.8–2.2 × 1.1–1.3 cm*, *short-pubescent with hairs 0.1–0.2 mm long*, *glabrescent*; pericarp 0.7–1.3 mm thick; stalk 0.3–0.7 cm long.

Vernacular name. Sarawak—*perupak* (Kelabit).

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In primary well-drained forest on low hills and ridges, also in *kerangas* forest, on tuff, sandy, and sandy loam soils, up to 1300 m altitude. Flowering mainly in June–November; fruiting in July–December.

3. **HORSFIELDIA** Willd.

(T. Horsfield, 1773–1859, sometime a medical doctor and naturalist in Indonesia)

darah-darah (Malay), *pisiah* (Bidayuh, Padawan),
umpo (Bidayuh, Sadong), *upang* (Bidayuh, Bau)

Sp. Pl. 4 (1806) 872; Warburg, Monogr. Myrist. (1897) 262; Gamble, J. As. Soc. Beng. 75, 2 (1912) 206; Ridley, FMP 3 (1924) 54; J. Sinclair, Gard. Bull. Sing. 16 (1958) 368, *ibid*. 27 (1974) 133, *ibid*. 28 (1975) 1; Backer & Bakhuizen *f*., FJ 1 (1964) 138; Whitmore, TFM 1 (1972) 322; Anderson, CLTS (1980) 263; W.J. de Wilde, Gard. Bull. Sing. 37 (1984) 115, *ibid*. 38 (1985) 55, 185, *ibid*. 39 (1986) 1; Blumea 32 (1987) 459, *ibid*. 41 (1996) 377; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 263; Coode *et al*. (eds.), CLBD (1996) 221; Argent *et al*. (eds.), MNDT-CK 2 (1997) 447.

Dioecious shrubs or trees; occasionally buttressesed. **Twigs** usually glabrescent, subterete or sometimes angular or ridged; bark usually striate, lenticellate. **Leaves** *distichous or in 3 or more rows along the twigs*; blades up to 45 cm long, membranous to coriaceous, *often brittle when dry*, pubescent or glabrescent, *lower surface not glaucous*, in some species non-traumatic cork warts present; intercostal venation reticulate, usually lax above, never forming a dense, close network as in *Knema*. **Inflorescences** rarely on the older branches (*H. sabulosa*), *paniculate*, *peduncled*, *usually branched several times but not from the base*, pubescent or glabrescent; at base of peduncle with few minute cataphylls; females smaller; bract caducous. **Flowers** usually pedicelled, glabrous or pubescent, solitary or in clusters, those in one inflorescence generally of about the same stage of development; pedicel at base articulated or not; *perianth* thin-coriaceous to succulent, 2–4-lobed, *inside glabrous*, greenish to yellowish, never red, the lobes cleft to various depths, *at anthesis never spreading*; *bracteole absent*. **Male flowers:** buds usually small, globose, transversely ellipsoid, reniform, pear-shaped, or clavate, laterally compressed or not; *synandrium* cup-shaped, or *almost globose to broadly ellipsoid*, or trigonous, laterally compressed or not, *sessile or with short androphore*; *anthers* 2–25, straight or curved or the apical parts incurved into the cavity of the central column, *entirely or largely connate*, *and adnate by their backsides to the narrow or broad*, *variously excavated central column*. **Female flowers:** buds usually larger than the males; ovary globose or ovoid, glabrous or pubescent, style absent, *stigma minutely 2-lobed*. **Infructescences** paniculate. **Fruits** globose or usually ellipsoid; pericarp usually fleshy, glabrous or pubescent, or subglabrescent; perianth sometimes persistent. **Seeds** ellipsoid, rarely globose, *not pointed at one end*; *testa not variegated*; *aril completely covering the seed*, *entire or at apex shallowly lobed or convoluted*; endosperm with fatty oil but no starch.

Distribution. More than 100 species ranging from Sri Lanka through NE India and S China to Malesia and the Caroline Islands and eastwards to the Solomon Islands and N Australia; absent from the Lesser Sunda Islands. Apart from a few widely distributed species, e.g. *H. irya*, most species are of limited distribution. In Sabah and Sarawak represented by 39 species, of which 9 species and 1 subspecies are endemic.

Ecology. In primary rain forest, often persisting in secondary growth, also in marshy forest. Stilt roots present in some species. Some species occur in montane altitudes, and the wide altitudinal range of the genus more or less contrasts with those of the other genera.

Key to *Horsfieldia* species

(for male flowering specimens)

1. Perianth predominantly 2-lobed, sometimes that of odd flower in one inflorescence 3- or 4-lobed……………………………………………………………………2
   Perianth predominantly 3- or 4-lobed……………………………………………………5

2. Leaves membranous, usually drying with whitish blotches of irregular shape and size. Androecium: anthers for the greater part connate, forming a saucer-shaped column; androphore distinct, tapering……………………………………………**13. H. irya**
   Leaves coriaceous or membranous, without whitish blotches. Androecium different.……………………………………………………………………………3

3. Leaves coriaceous, lower surface with thin tomentum and with dark dots and streaks…………………………………………………………………**6. H. crassifolia**
   Leaves more or less membranous, lower surface glabrous or early glabrescent, without dark dots or streaks……………………………………………………………………4

4. Androecium depressed globose, largely consisting of anthers; apical cavity of column flat and shallow; anthers 7…………………………………………………**35. H. sucosa**
   Androecium broadly obovoid, consisting of a large sterile basal part and at apex with 3 or 4 small anthers………………………………………………………**33. H. sterilis**

5. Leaves in 3 or more rows along the twigs. Leaf bud short and broad (less than 4 times longer than broad)…………………………………………………………………6
   Leaves distichous (in rare cases a few on the same plant in 3 rows). Leaf bud more slender……………………………………………………………………………………8

6. Leaves more or less clustered towards the end of the twigs. Leaf bud and inflorescence pubescent with hairs 0.5–1.5 mm long. Bark of older twigs often blackish, conspicuously

flaking……………..…………….........................………………………………..**30. H. sabulosa**
Leaves clustered or not. Leaf bud and inflorescence pubescent with hairs up to 0.3 mm long. Bark of older twigs not or slightly flaking…………………………........………..7

7. Bark of twig brown, not contrasting with the colour of drying petiole…..………..
…………………………………………………….....…………**10. H. fragillima** (in part)
Bark of twig pale, greyish or straw, contrasting with the blackish brown colour of the drying petiole……..……………………………………..**22. H. pallidicaula** (in part)

8. Leaves scabrous above…………………………....……………………….……**12. H. grandis**
Leaves not scabrous above…………………………………....……………………….……9

9. Petiole almost absent. Twigs 5–7(–10) mm diameter. Leaves 25–70 cm long, with persistent tomentum beneath…………………………..............…………**31. H. sessilifolia**
Petiole present. Twigs generally more slender. Leaves various……........…………………10

10. Flower bud ellipsoid, 2.8–3.7 mm long; perianth at anthesis clefts to 1/5–1/3. Leaves more or less parchment-like, bullate (matted above with finely wrinkled surface)
……………………………………………………………….....…….....……**37. H. tristis**
Flower bud either broadly ellipsoid, subglobose, broadly obovoid, or short pear-shaped, *c.* 3.5 mm long or less, or (depressed)globose; perianth at anthesis clefts to (1/4–) 1/3 or more. Texture of leaves various, not bullate………………........……........……..11

11. Leaves with (sub)persistent tomentum beneath. (In *H. gracilis* and *H. wallichii* sometimes hairs remaining only on and near midrib and lateral veins)……….......……….12
Leaves glabrous or early glabrescent beneath (in some species with hairs remaining on the lower midrib)………………………………………..........………………………18

12. Leaves with dots and/or streaks beneath………………......……………………………13
Leaves without dots or streaks beneath…………………....……………………………..14

13. Flower bud broadly obovoid, 2–2.5 mm long; pedicel tapering, 0.3–1 mm long. Twig 3–6(–9) mm diameter. Leaves thinly pubescent beneath, often somewhat glabrescent…………………......……………………………**38. H. wallichii** (in part)
Flower bud subglobose, 1–1.5 mm diameter; pedicel slender, terete, 0.5–1.5 mm long. Twig 2–3 mm diameter. Leaves with conspicuous tomentum beneath…..................………
……………………………………....……………....…..……**23. H. paucinervis**

14. Flower bud *c.* 1 mm diameter, with persistent tomentum or late-glabrescent…………
……………………………………………………….....………………**17. H. motleyi**
Flower bud 1–2.5 mm diameter, glabrous or glabrescent…………......………………..15

15. Pedicel not or indistinctly articulated at the base (character not quite clear in *H. rufo-lanata* and *H. gracilis*)…………………………........……………………………..16
Pedicel articulated at the base……......………………………….……………....**27. H. reticulata**

16. Flower bud *c.* 1 mm diameter. Twig at apex 1.5–2.5 mm diameter. Leaves: intercostal venation indistinct above; lower surface with hairs remaining on lateral veins and

midrib only…………….............……………………………………..**11. H. gracilis**
Flower bud 1.5–2.3 mm diameter. Twig at apex 3.5–7(–13) mm diameter. Leaves: intercostal venation distinct above; persistent tomentum distinct beneath…........……17

17. Leaves 18–45 cm long; lateral veins 18–25 pairs, sunken above. Flower bud 1.5–2 mm diameter; anther 8–10.………………...………………….………**32. H. splendida**
Leaves 10–23 cm long; lateral veins 11–16 pairs, raised above. Flower bud 2–2.3 mm diameter; anthers *c.* 15………..............………………………....**29. H. rufo-lanata**

18. Twig pale, greyish or straw, contrasting with the dark brown colour of the drying petiole…………………………............…………...……………………………..19
Twig (dark) grey-brown, not contrasting with the drying petiole…………................…22

19. Androecium triangular in cross section. Anthers free for the upper half or more………
……………...…………...………………………………………………**21. H. oligocarpa**
Androecium (sub)circular in cross section. Anthers largely connate…....………20

20. Leaves chartaceous to coriaceous; upper surface drying bright brown. Mostly in *kerangas* forest on sandy soils……………….....................……………**5. H. carnosa**
Leaves membranous or thinly chartaceous, upper surface drying (blackish) brown. Usually growing in forest on richer soils, including sandy soils…...............………21

21. Fruit 4 cm long or less…………………………………...**22. H. pallidicaula** (in part)
Fruit 5 cm long or more. (Male flowers not known)…………......……….**7. H. discolor**

22. Twig (also the older ones) ridged or nearly winged……….…...……...**4. H. brachiata**
Twig not ridged, sometimes faintly ridged, lined, or angular in the apical part only..23

23. Flower bud short pear-shaped, 2–2.5 mm long, subsessile with the pedicel thickish, much shorter than the perianth, 0.3–1 mm long. Leaves with fine dots and streaks beneath. Twig hollow……………...............……………...**38. H. wallichii** (in part)
Flower bud various, the pedicel proportionally longer and more slender. Leaves with or without dots (never streaks) beneath. Twig solid or faintly hollow…….....................24

24. Androecium 3- or 4-angular in cross section; anthers more or less erect, free for about halfway or more. Leaf without blackish dots beneath. Pedicel indistinctly articulated…………………………………………………....……………………25
Androecium circular, subcircular, or subtriangular with rounded angles in cross section; anthers more or less curved, almost entirely connate. Leaf with or without dots beneath. Pedicel articulated or not……………………………..…….....................……..32

25. Leaves with midrib and lateral veins more or less level or sunken above……...……26
Leaves with midrib and lateral veins raised above…………………………...………27

26. Twig and inflorescence glabrescent. Leaf apex acute or acute-acuminate; lateral veins faint above. Anthers 4–6……………….........…………………**28. H. ridleyana**
Twig late-glabrescent, inflorescence with persistent tomentum. Leaf apex blunt; lateral veins flat or slightly raised above, clearly visible. Anthers 9 or 10...**20. H. obtusa**

27. Leaves and midrib glabrous beneath; apex long acute-acuminate. Twig rather smooth, lower down longitudinally cracked..……………………..........……**8. H. disticha**
Leaves early glabrescent beneath, but midrib sometimes late-glabrescent; apex acute-acuminate. Twig striate, lower down coarsely striate or finely cracked….................28

28. Twig 1–3(–4) mm diameter. Leaves thinly membranous to subchartaceous; petiole 0.1–0.15(–0.2) cm diameter. Inflorescence delicate, up to 10 cm long...……….......29
Twig 2–5(–13) mm diameter. Leaves chartaceous to thickly coriaceous; petiole 0.15–0.4(–0.8) cm diameter. Inflorescence up to 15(–20) cm long...………………...….30

29. Leaf bud pubescent with hairs (0.1–)0.2(–3) mm long. Twig at apex glabrescent. Inflorescence pubescent with sparse stellate hairs 0.1–0.2 mm long, glabrescent. Leaves glabrous, upper surface drying olivaceous to brown. Flower bud subglobose, tapering into the pedicel……………......................……………....……………**36. H. tenuifolia**
Leaf bud, apical part of twig, petiole, midrib beneath and inflorescence pubescent with woolly stellate-dendroid hairs (0.2–)0.5 mm long. Upper surface of leaves drying dull olivaceous. Flower bud globose or depressed globose………….**15. H. macilenta**

30. Twig and leaves stout; midrib broad above, at the transition to the petiole at least 3 mm wide. Inflorescence 10–20 cm long…………....…………**14. H. laticostata**
Twig and leaves less robust; midrib above towards the insertion of the petiole narrow, less than 3 mm wide. Inflorescence up to 15(–20) cm long………….............…...31

31. Leaves 16–28 cm long; base more or less rounded or short-attenuate; lateral veins 16–19 pairs, very prominent above…………………......………………**18. H. nervosa**
Leaves 7–28 cm long; base short- to long-attenuate; lateral veins 6–15 pairs, raised to various degree above. (On drying, colour of leaves above and beneath usually much contrasting, generally more so than in the related species)…..**25. H. polyspherula**

32. Leaf bud, apical part of twig, and inflorescence tomentose with hairs *c.* 0.2 mm long or more……………………………………………………………………………...33
Leaf bud, apical part of twig, and inflorescence tomentose with hairs 0.1(–0.2) mm long or less………………..............…………………………......……………………..38

33. Flower bud ellipsoid, 2.5–3.5 mm long; androecium longer than broad. Leaves thick and brittle, lower surface usually with conspicuous pale golden hair scars (lens!)…………………………....……………………...………………**9. H. endertii**
Flower bud depressed globose or (sub)globose, (1–)1.4–2.2(–2.5) mm diameter; androecium not longer than broad. Leaves various, without golden hair scars..….34

34. Leaves with dots beneath (lens!). Pedicel articulated..……....…...**3. H. borneensis**
Leaves without dots beneath. Pedicel not articulated………………..........……….35

35. Male flower bud 2–2.5 mm diameter; androecium sessile, broadly saucer-shaped. Leaves 20–45 cm long. Lowland forest……......……...**10. H. fragillima** (in part)
Male flower bud (1–)1.4–2.2 mm diameter; androecium (depressed)globose, sessile or with short androphore, the apical cavity small, concealed by the apices of the anthers. Leaves 4–35 cm long. Hill to montane forests at 800–2000 m altitude…….36

36. Androecium with slender androphore 0.4–0.8 mm long, not hidden by the anthers……………………………………………………………......…………...**2. H. androphora**
Androecium (sub)sessile, androphore absent or up to 0.5 mm long, largely hidden by the anthers………………………..........…………………………………………...37

37. Leaves chartaceous or membranous, up to 35 cm long; upper surface drying olivaceous; apex acute-acuminate. Inflorescence up to 20 cm long……….........................……………………………………………………………………...………..**1. H. amplomontana**
Leaves coriaceous, 4–14 cm long; upper surface drying blackish; apex obtuse to subacute. Inflorescence 4–16 cm long……….......……………………**16. H. montana**

38. Leaves with dots beneath……………………….....………………...……………..…41
Leaves without dots beneath (dots should not be confused with smaller, blackish points)……………………………......…………………………………………….39

39. Perianth coriaceous, lobes at base (0.3–)0.4–1 mm thick. Androecium broadly obovoid, longer than broad; androphore rather broad, tapering, (0.1–)0.2–0.3 mm long. Leaves coriaceous..……………………………………..............……………...**39. H. xanthina**
Perianth thinner, lobes at base 0.2–0.3 mm thick. Androecium subglobose, depressed globose-ovoid, ellipsoid, or broadly obovoid, not or little longer than broad; androphore narrow, only *c.* 0.2 mm long. Leaves membranous or chartaceous……..........…40

40. Perianth of flower bud clefts for *c.* 1/2 at anthesis……….....….**34. H. subalpina**
Perianth of flower bud clefts for 2/3–4/5 at anthesis…………………**19. H. obscura**

41. Twig 2.5–4(–10) mm diameter. Leaves 9–21 cm long or more. Flower bud depressed globose, 1.6–2.2 mm diameter………………………......……..**26. H. punctatifolia**
Twig 1.5–2(–4) mm diameter. Leaves 6–14(–17) cm long. Flower bud subglobose, *c.* (1.5–)2 mm diameter………………………....……………...**24. H. penangiana**

Key to *Horsfieldia* species

(for female flowering and fruiting specimens)

1. Perianth 2-lobed.......…………...………………………………………......…………2
Perianth predominantly 3–4-lobed………….......……………………...………………5

2. Leaves membranous, upper surface usually with irregularly shaped whitish blotches here and there. Fruits globose. Seeds globose.......………….........……..**13. H. irya**
Leaf texture various, upper surface usually without whitish blotches. Fruits subglobose, ovoid, obovoid, oblong, or ellipsoid. Seeds ellipsoid or almost globose…………3

3. Leaves coriaceous; lower surface usually densely short-pubescent and with scattered brownish or blackish dots and streaks. Twig grey-brown, not much contrasting with the colour of the drying petiole...…………...………........…..……**6. H. crassifolia**
Leaves membranous; lower surface glabrous or early glabrescent, without brownish or blackish dots or streaks. Twig greyish or straw, rather contrasting with the blackish colour of the drying petiole......……...........…………………………………………4

4. Female inflorescences more or less spike-like, 5–10 cm long. Perianth persistent under the fruit.......……………........………………………………………..**33. H. sterilis**
Female inflorescences branched, 1–2 cm long. Perianth not persisting under the fruit………………………………….......…………………………...**35. H. sucosa**

5. Leaves in 3 or more rows along the twig.......…......…………………………………6
Leaves distichous.........………………………........……………………………………....8

6. Leaves generally bunched towards the apex of the twig. Petiole 2.5–5 cm long……
…………………………………...………………………………………...**30. H. sabulosa**
Leaves not bunched at the apex of twig. Petiole (0.2–)0.4–2.5 cm long........….........……7

7. Leaves 10–30 cm long. Twig pale greyish or straw, contrasting with the blackish colour of the drying petiole. Female flower buds 2.5–3 mm long. Fruits 1.5–4 cm long……………………………......……………………**22. H. pallidicaula** (in part)
Leaves 20–45 cm long. Twig brown, in colour not contrasting with the drying petiole. Female flower buds 4–5 mm long. Fruits 6–8 cm long........**10. H. fragillima** (in part)

8. Apical portion of twig angular, i.e. distinctly lined or ridged from petiole to petiole…………………………………………...…....……………...**4. H. brachiata**
Apical portion of twig terete, subterete or faintly angular, neither distinctly lined nor ridged....………....………………………………………………………………9

9. Leaves on lower surface with persistent or subpersistent tomentum......………......……..10
Leaves on lower surface glabrous or early glabrescent (midrib sometimes late-glabrescent)....………………………………......……………….......…...……………18

10. Leaves *c*. 50 cm long; petiole 0.2–0.3 cm long.......………...……**31. H. sessilifolia**
Leaves usually less than 40 cm long; petiole much longer.......….......……………11

11. Older leaves on both surfaces with scabrous hair scars. Fruits 1–1.4 cm long..........…
……………………………………………………………...……...……**12. H. grandis**
Leaves not scabrous. Fruits generally larger.......……....………....…………………..12

12. Leaves on lower surface with scattered dark brown or blackish dots and/or streaks.....……………………………....………...…...….**38. H. wallichii** (in part)
Lower leaf surface with or without dots, but always without streaks.......…………....……13

13. Perianth with persistent tomentum, not persistent under mature fruit......**17. H. motleyi**
Perianth glabrous or early glabrescent, persistent under mature fruit or not........…14

14. Ovary pubescent. Fruit sometimes pubescent only towards the base.........………15
Ovary and fruit glabrous........………………………………...………………….16

15. Twig moderately stout, towards apex 3.5–5(–7) mm diameter. Leaves 10–23 cm long; lateral veins 10–16 pairs. Fruits largely glabrescent; perianth not persistent....…..……
…………………….…………………………………….....…………**29. H. rufo-lanata**
Twig stouter, toward apex 4–7(–13) mm diameter. Leaves 18–45 cm long; lateral veins 18–25 pairs. Fruits pubescent, with persistent perianth....…..**32. H. splendida**

16. Twig rather stout, towards apex 2.5–6(–9) mm diameter. Leaves 18–35 cm long; surface sometimes bullate; lateral veins (9–)17–20 pairs. Fruits 2.3–2.7 cm long………………………………………………………………………………**27. H. reticulata**
Twig slender, towards apex 1.5–3 mm diameter. Leaves generally smaller; surface not bullate; lateral veins 5–17 pairs. Fruits 1–1.5 cm long……………………………………17

17. Leaves membranous; lateral veins 12–17 pairs; brownish or blackish dots on lower leaf surface absent…………………………………………………………**11. H. gracilis**
Leaves thinly chartaceous; lateral veins 5–9(–11) pairs; brownish or blackish dots on lower leaf surface present……………………………………………**23. H. paucinervis**

18. Lower leaf surface with more or less regularly spaced, brownish or blackish dots or with dots and streaks (dots originating from hair scars, not to be confused with usually smaller and irregularly spaced dots or punctation of different origin)……19
Lower leaf surface without blackish dots (sometimes with enlarged hair scars)……22

19. Tomentum of leaf buds, twig apices and young inflorescences composed of hairs *c.* 0.2 mm long or more………………………………………………………………20
Tomentum of leaf buds, twig apices and young inflorescences consisting of hairs up to 0.1 mm long……………………………………………………………………21

20. Twigs usually conspicuously hollow. Leaves on lower surface often with persistent tomentum. Pedicel at base not articulated. Perianth generally persistent under the fruit……………………………………………………**38. H. wallichii** (in part)
Twigs not conspicuously hollow. Lower leaf surface early glabrescent. Pedicel at base articulated. Perianth not persistent under the fruit…………………**3. H. borneensis**

21. Twig slender, towards apex 1.5–2(–4) mm diameter. Leaves 6–14(–17) cm long; lateral veins 8–11 pairs. Fruits *c.* 1.5 cm long; pericarp *c.* 1.5 mm thick……………………………………………………………………………………**24. H. penangiana**
Twig stout, towards apex 2.5–4(–10) mm diameter. Leaves 9–21 cm long; lateral veins 11–16 pairs. Fruits 4.5–8 cm long; pericarp 10–20 mm thick……**26. H. punctatifolia**

22. Bark of twig drying to a pale colour, grey-brown or grey-yellowish, contrasting with the dark brown or blackish colour of the drying petiole…………………………23
Bark of twig drying dark brown, not or slightly contrasting with the colour of drying petiole……………………………………………………………………………27

23. Leaves membranous, upper surface drying brown or blackish brown, the lower surface somewhat paler. Perianth persistent under the fruit…………**22. H. pallidicaula** (in part)
Leaves usually chartaceous, upper surface drying bright brown or olivaceous, lower surface usually brown or chocolate. Perianth not persistent under the fruit……….24

24. Twig slender, towards apex 2–3 mm diameter. Leaves 7–16 cm long, lower surface bright brown or chocolate, contrasting well with the grey-olivaceous upper surface……………………………………………………………**21. H. oligocarpa**
Twig stout, towards apex 3–10 mm diameter. Leaves 13–35 cm long, lower and upper surfaces not conspicuously contrasting in colour……………………………………25

25. Fruits 5 cm long or more. Upper leaf surface not finely wrinkled on drying……………………………………………………………………………………**7. H. discolor**
Fruits 2 cm long or less. Upper leaf surface finely wrinkled on drying……………26

26. Leaves oblong to elliptic-oblong. Fruits 1.6–2 cm long…………………**5. H. carnosa**
Leaves lanceolate to elliptic-oblong. Fruits up to 1.5 cm long……………**37. H. tristis**

27. Tomentum of leaf buds and young inflorescences very short, consisting of hairs up to 0.1 mm long. Leaf lateral veins on upper leaf surface flat or sunken, or slightly raised……………………………………………………………………………28
Tomentum of leaf buds and young inflorescences composed of hairs 0.1 mm long or more. Leaf lateral veins raised or not above; if hairs only *c*. 0.1 mm long, then the lateral veins, at least in the lower half, distinctly raised above……………30

28. Leaves membranous…………………………………………………**19. H. obscura**
Leaves membranous, chartaceous or coriaceous……………………………………29

29. Leaves on lower surface without distinct large hair scars. Fruits 3–5 cm long……………………………………………………………………………**34. H. subalpina**
Leaves on lower surface usually with distinct enlarged hair scars. Fruits *c*. 5 cm long………………………………………………………………………**39. H. xanthina**

30. Pedicel at base not articulated (this character best seen in male flowers). Fruits with persistent perianth or not……………………………………………………31
Pedicel at base articulated. Perianth not persistent in fruits…………………………35

31. Leaves 15–45 cm long. Fruits *c*. 6 cm long or more; perianth persistent for a long time……………………………………………………………………………32
Leaves 5–20 cm long. Fruits 2–4.2 cm long; perianth not persistent…………………33

32. Lateral veins 11–12 pairs…………………………………………**1. H. amplomontana**
Lateral veins 20–30 pairs……………………………………**10. H. fragillima** (in part)

33. Leaves membranous; apex acute-acuminate. Fruits 2.4–3 cm long…………**2. H. androphora**
Leaves chartaceous to thickly coriaceous; apex rounded to subacute. Fruits 2–4.2 cm long…………………………………………………………………………34

34. Leaves chartaceous to coriaceous; lower surface without large hair scars. Female flower buds *c*. 2 mm long. Fruits 2–2.7 cm long……………………………**16. H. montana**
Leaves usually thickly coriaceous, usually with large and distinct hair scars on lower surface. Female flower buds 2.5–3 mm long. Fruits 3–4.2 cm long…………**9. H. endertii**

35. Midrib on upper leaf surface towards the transition to the petiole *c*. 3 mm broad or more…………………………………………………………………**14. H. laticostata**
Midrib at the base narrow……………………………………………………………36

36. Leaves 16–28 cm long; base short-attenuate to rounded; lateral veins 16–19 pairs…………………………………………………………………………**18. H. nervosa**

Leaves 5–28 cm long; base either rounded or short- or long-attenuate; lateral veins 5–18 pairs...37

37. Lateral veins on upper leaf surface sunken or flattish, or slightly raised......................38
Lateral veins distinctly raised above...39

38. Leaf apex rounded...**20. H. obtusa**
Leaf apex acute-acuminate...**28. H. ridleyana**

39. Tomentum of leaf buds and young inflorescences comprising hairs 0.1–0.2(–3) mm long. Leaves drying dull greyish-brown, the colours of the upper and lower surfaces not much contrasting. Fruits 1.7–2 cm long.......................................**36. H. tenuifolia**
Tomentum of leaf buds and young inflorescences consisting of hairs *c*. 0.2 mm long or more; or if hairs *c*. 0.1 mm long, then the olivaceous to dark brown colour of the dry leaf above much contrasting with the cinnamon colour beneath. Fruits 1.9–6 cm....40

40. Twig slender, towards apex 1–3 mm diameter. Leaves generally membranous, 10–18(–27) cm long...**15. H. macilenta**
Twig generally stouter, towards apex 2–5 mm diameter. Leaves chartaceous, of various sizes...41

41. Twig early glabrescent; older bark more or less longitudinally cracked. Leaf apex long acute-acuminate. Fruits 2.8–3.2 cm long; pericarp hard and woody, 8–10 mm thick...**8. H. disticha**
Twig usually rather late-glabrescent; older bark striate, not cracked. Leaf apex acute-acuminate, the acumen not conspicuously long. Fruits 1.9–6 cm long; pericarp not so, 2–15 mm thick..**25. H. polyspherula**

1. **Horsfieldia amplomontana** W.J. de Wilde

(Latin, *amplum* = large; resembling *H. montana*, but much larger)

Gard. Bull. Sing. 39 (1986) 34; Whitmore, Tantra & Sutisna *l.c.* 263. **Type:** *Clemens 30536*, Borneo, Sabah (holotype L; isotypes BM, K).

Tree up to 20 m tall. **Bark** grey, fissured, soft, *c*. 5 mm thick; inner bark white, soft, *c*. 5 mm thick; sap sticky. **Sapwood** white. **Twigs** *solid*, *terete or faintly angular*, *not ridged*, *towards apex 3.5–6(–10) mm diameter*, *drying brown*, *not contrasting with the drying petiole*, glabrescent, *tomentum comprising hairs 0.3–1(–1.5) mm long*; lenticels inconspicuous; older bark not flaky. *Leaf buds 15–22 × 3–4 mm*, *tomentose with hairs 0.5–1(–1.5) mm long*. **Leaves** *distichous*, *membranous to chartaceous*, *upper surface not scabrous*, glabrescent, *drying olivaceous*, *lower surface glabrous*, *without blackish dots*, *without pale hair scars*; oblong, *15–35 × 5–11 cm*, base attenuate to rounded, *apex acute-acuminate*; midrib flattish to moderately raised above; *lateral veins 11–12 pairs*, *flattish to raised above*; *petiole 0.8–1.5 cm long*. **Inflorescences** *pubescent with shaggy hairs c. 0.5 mm long*; males 3 or 4-times branched, many-flowered, *10–21 × 10–16 cm*, peduncle 15–40 mm long; females not seen, in fruit 7–8 cm long; bract 2–7 mm long, caducous. **Male flowers:** *pedicel not articulated*, 0.8–2 mm long; *buds slightly depressed globose*, *1.5–2 × 2–2.2 mm*, not or slightly collapsing on drying; *perianth 3–4-lobed*, lobes *c.* 0.2 mm thick, *at anthesis clefts to 1/2–2/3*; *androecium (sub)sessile*, *depressed globose*, rounded or sagged at base, *0.6–1 × 1.1–1.8 mm*, *in transverse section circular*; *apical excavation small*, *concealed by the apices of the anthers*, *anthers* 10–13, sessile, free apices up to 0.1 mm long, *curved and more or less entirely connate*, *concealing the more or less 3-radiate*, *0.2–0.5 mm deep cavity of the column*; *androphore narrow*, *0.1–0.4 mm long*, *hidden by the anthers*. **Fruits** 1–3 per infructescence, *ellipsoid*, *7–8 × 4.5–5 cm*, glabrous, tubercled; *pericarp c. 15 mm thick*; stalk *c.* 3 mm long, at base not articulated; *perianth persistent*. **Seeds** *ellipsoid*; aril red.

Distribution. Endemic to Borneo; confined to Mt. Kinabalu, Sabah.

Ecology. In primary and degraded hill to lower montane forests on sandstone, at altitude of 1000–1500 m. Flowering in November–December and February; fruiting in November.

2. **Horsfieldia androphora** W.J. de Wilde

(Greek, *andro* = male, *phorus* = bearing; the well developed androphore of the androecium)

Gard. Bull. Sing. 39 (1986) 32; Whitmore, Tantra & Sutisna *l.c.* 263. **Type:** *Nooteboom & Chai 1710*, Borneo, Sarawak, Kapit district, Bt. Goram (holotype L; isotypes K, SAR).

Tree up to 20 m tall. **Bark** chocolate to reddish brown, narrowly cracked or longitudinally furrowed and cut into rectangular blocks; sap watery, more or less colourless (in flowering tree) or blood red (in fruiting tree). **Twigs** *solid*, *terete or only faintly angular*, *not ridged*, *towards apex 2–4(–5) mm diameter*, *rusty tomentose with hairs 0.3–0.6 mm long*, late-glabrescent; *bark drying brown*, *not contrasting with the drying petiole*, not flaky; lenticels not conspicuous. *Leaf buds 8–12 × 2–3 mm*, *pubescent with hairs 0.3–0.6 mm long.* **Leaves** *distichous*, *membranous*, *upper surface drying dark brown*, *not bullate*, *not scabrous*, glabrous, *lower surface early glabrescent* except the midrib, *without blackish dots and golden hair scars*; elliptic to oblong, *9–18 × 3.5–6.5 cm*, base attenuate, *apex acute-acuminate*; midrib raised above, late-glabrescent beneath; *lateral veins* 9–13 pairs, *raised above*; *petiole 1–1.2 cm long*. **Inflorescences** *tomentose with hairs 0.2–0.6 mm long*; bract *c.* 3 mm long, caducous; males many-flowered, 3(–4)-times branched, 6–14 × 3.5–9 cm, peduncle 10–20 mm long; females 3–4 cm long. **Male flowers:** *pedicel* 0.5–2 mm long, slender, *at base not articulated*; *buds (sub)globose*, *1.4–2.2 mm diameter*; *perianth* glabrous, *3-lobed*, *at anthesis clefts to 1/3 to nearly 1/2*, lobes *c.* 0.2 mm thick; *synandrium depressed globose*, *in transverse section circular*, *0.6–1 × 0.8–1.3 mm*; *androphore slender*, *0.4–0.8 mm long*; *anthers* 7–11, *curved*, sessile, and *almost entirely connate*, *concealing the 0.2–0.3 mm deep apical cavity of the column*. **Fruits** 2–5 per infructescence, *ellipsoid*, *2.4–3 × 1.4–2 cm*, glabrous, finely tubercled; dry pericarp 1.5–2 mm thick; stalk *c.* 2 mm long; *perianth not persistent*. **Seeds** *ellipsoid*; outer seed coat whitish grey; aril orange.

Vernacular name. Sarawak—*liang* (Kelabit).

Distribution. Endemic to Borneo (Sabah and Sarawak).

Ecology. In hill to lower montane mossy forests, wooded sandstone ridges, at altitudes of 800–1200 m. Flowering in March and October; fruiting in March and June.

3. **Horsfieldia borneensis** W.J. de Wilde

(of Borneo)

Gard. Bull. Sing. 39 (1986) 27, *l.c.* (1987) 468; Whitmore, Tantra & Sutisna *l.c.* 263. **Type:** *Bojang S. 14610*, Borneo, Sarawak (holotype L; isotypes K, SAR).

Tree up to 30 m tall. **Bark** rough, deeply fissured, flaking in squares, usually dark brown or reddish or blackish, strips or flakes up to 5 cm wide, up to 1 cm thick; inner bark 5–10 mm thick, red-brown; sap red. **Sapwood** reddish white to pale red; heartwood red-brown. **Twigs** *subterete*, *not conspicuously hollow*, *not ridged*, *towards apex (1.5–)2–4(–10) mm diameter*, *brown*, *not contrasting with the drying petiole*, *rusty tomentose with hairs 0.2–0.4 mm long*, glabrescent; lower down finely striate, not distinctly lenticellate, when older finely cracked or flaky or not. *Leaf buds 10–17 × 2–4 mm*, *densely pubescent with hairs c. 0.3 mm long*. **Leaves** *distichous*, chartaceous to thinly coriaceous, *upper surface drying dull olivaceous to brown*, *not bullate*, *not scabrous*, glabrous, *lower surface* drying pale brown or chocolate, *tomentose with shortish densely branched dendroid hairs 0.3–0.4 mm long* (especially on the midrib), *early glabrescent*, *without golden hair scars*, *always with scattered blackish dots*; elliptic-oblong to oblong-lanceolate, 7–18 × 2–6 cm, base short-attenuate, apex acute to short-acuminate; midrib slightly raised above, early or late-glabrescent; lateral veins 10–16 pairs, flat or sunken (or close to the midrib slightly raised) or in thinner-leaved specimens slightly raised above; intercostal venation hardly visible on both surfaces; *petiole 1.2–2.5 cm long*, late-glabrescent. **Inflorescences** on older twigs behind the leaves, *woolly pubescent with rusty hairs up to 0.7 mm long*; bract 1.5–5 mm, caducous; males fairly large, *c.* 4-times branched, (8–)13–20 × (5–)10–18 cm, peduncle 15–35 mm long; females stout, on older twigs *c.* 1.5 cm thick well below the leaves, rather many-flowered, 8–10 × 4–5 cm, peduncle *c.* 15 mm long. **Male flowers** in loose clusters of 2–6; *pedicel 1–1.5 mm long*, glabrous, *articulated at base*; *buds subglobose to broadly ellipsoid* or obovoid, *1.3–1.8 × 1.2–1.7 mm*, apex broadly rounded, base narrowly rounded; *perianth* glabrous, *3-lobed*, *at anthesis clefts to c. 1/3 to nearly 1/2*, not collapsing on drying; *androecium subglobose*, *0.7–1.2 × 0.6–1.3 mm*, *circular to rounded-subtriangular in cross section*, *sessile*, apex broadly rounded, slightly impressed in the centre to 1/5–1/4 or less; *anthers* 7–10, almost completely sessile and *entirely connate*, *at apex incurved over the cavity of the column*. **Female flowers** solitary or 2–4 together; *pedicel* rather thick, 1–1.5 mm long, *at base articulated*; buds subglobose or broadly ellipsoid, *c.* 3–3.5 × 3 mm; ovary subglobose 2(–2.5) × 2 mm, glabrous. **Infructescences** up to 13 cm long. **Fruits** 1–7 per infructescence, ovoid, somewhat laterally flattened and slightly flanged, apex and base rounded, 4–6 × 3–4.5 cm, glabrous, drying often with a glaucous tinge, rather smooth; dry pericarp 10–15 mm thick; stalk stout, 4–6 mm long; *perianth not persistent*. **Seeds** *ellipsoid*; aril orange.

Distribution. Endemic to Borneo (Sabah, Sarawak, E and NE Kalimantan).

Ecology. In primary lowland mixed dipterocarp forest and swamp forest, on sandy clay soils, up to 200 m altitude. Flowering in April and August–September; fruiting throughout the year.

4. **Horsfieldia brachiata** (King) Warb.

(Latin, *brachiatus* = much-branched; the male inflorescence)

Monogr. Myrist. (1897) 325; Gamble *l.c.* 218; Ridley *l.c.* 59; Whitmore *l.c.* 325; J. Sinclair *l.c.* (1975) 8; Anderson *l.c.* 263; W.J. de Wilde *l.c.* 39 (1986) 3; Turner *l.c.* 358; Coode *et al.* (eds.) *l.c.* 221; Argent *et al.* (eds.) *l.c.* 447. **Basionym:** *Myristica brachiata* King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 311. **Lectotype:** *Griffith 4351*, Malacca (hololectotype CAL; isolectotypes A, CGE, K, M, P, S, U). **Synonyms:** *H. subglobosa* (Miq.) Warb. var. *brachiata* (King) J. Sinclair *l.c.* 16 (1958) 431; *H. brachiata* (King) Warb. var. *brachiata* J. Sinclair *l.c.* (1975) 9.

Tree up to 35 m tall. **Bark** more or less smooth, pale brown to dark brown, shallowly fissured, laminated or scaly, or cracked; inner bark 8–10 mm thick, pinkish to reddish brown; sap reddish. **Sapwood** whitish to pale brown. **Twigs** *more or less angular* or flattened, *towards apex 2–7(–18) mm diameter*, *mostly lined or ridged or nearly winged between the petioles*, at first rusty tomentose with hairs (0.1–)0.2–0.4 mm long, generally early glabrescent; bark lower down striate, *(dark) brown*, *not contrasting with the drying petiole*, not flaky. *Leaf buds 8–15 × 3–4 mm*, pubescent with hairs 0.2–0.4 mm long. **Leaves** *distichous*, membranous, *upper surface glabrous*, *drying olivaceous to brown*, *not bullate*, *not scabrous*, *lower surface* drying light brown, *early glabrescent* but midrib sometimes late-glabrescent, *without dark dots*; elliptic-oblong to oblong-lanceolate, 12–26(–30) × 4–9(–11) cm, base cuneate, apex acute-acuminate; midrib raised above; lateral veins 12–20 pairs, raised above; intercostal venation not distinct; *petiole 0.8–1.3(–2) cm long*. **Inflorescences** sparsely to densely pubescent with hairs 0.2–0.5 mm long, sometimes partly glabrescent; bract 3–5 mm long, pubescent, caducous; males 3–4-times branched, 7–18(–22) × 5–16(–18) cm, peduncle 6–18 mm long, flowers in loose clusters of 3–6; females 3–8 × 2–6 cm. **Flowers:** *perianth 3(–4)-lobed*, glabrous; pedicel pubescent in various degree with hairs 0.1–0.2 mm long, or glabrescent, *at base more or less articulated*. **Male flowers:** pedicel (1–)1.5–2.5 mm long; *buds subglobose or broadly obovoid*, in transverse section slightly angular or rounded, *1–1.5 × 1.2–1.8 mm*, apex broadly rounded, base rounded to short-cuneate; *perianth at anthesis clefts to 1/2–2/3*, not or only slightly collapsing on drying; *androecium* depressed globose to obovoid, (0.5–) 0.7–1 × 0.8–1.2 mm, *more or less 3-angular in transverse section*; anthers 6–10, for *c*. halfway free, curved towards the centre, column deeply excavated; androphore short. **Female flowers:** pedicel 1–1.5 mm long; *buds broadly ellipsoid*, *2.2–2.5 × 1.8–2 mm*; ovary ovoid, 1–1.4 × 0.8–1.2 mm, glabrous. **Fruits** 4–12(–20) per infructescence, broadly ellipsoid, base broadly rounded, *2–2.8(–4) × 1.8–2.2(–3) cm*, apex narrowly rounded, glabrous, drying brown, not warted nor lenticellate; dry pericarp 1.5–4(–7) mm thick; stalk 1.5–3 mm long; perianth not persistent. **Seeds** ellipsoid.

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, and Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In primary and degraded lowland and hill rain forests on various types of well-drained and water-logged soils, up to 400 m altitude. Flowering and fruiting throughout the year.

5. **Horsfieldia carnosa** Warb. Fig. 3.

(Latin, *carnosus* = succulent; the leaves)

Monogr. Myrist. (1897) 348; Merrill *l.c.* (1921) 268; Masamune *l.c.* 300; J. Sinclair *l.c.* 28 (1975) 21; Anderson *l.c.* 264; W.J. de Wilde *l.c.* (1985) 222; Whitmore, Tantra & Sutisna *l.c.* 263; Coode *et al.*

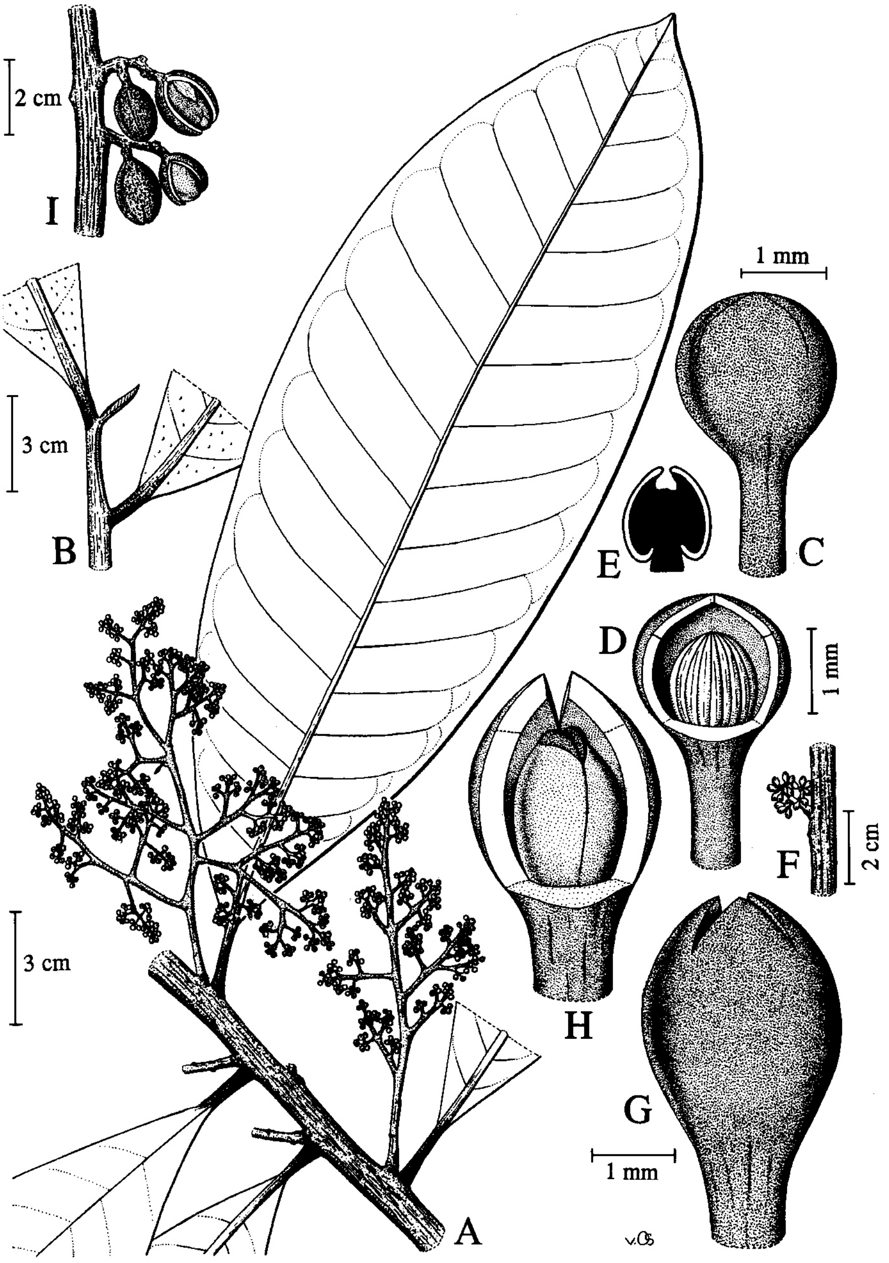

Fig. 3. *Horsfieldia carnosa.* A, portion of flowering (male) leafy twig; B, apical portion of leafy twig; C, mature male flower bud; D, opened mature male flower bud; E, schematic diagram of longitudinal section of androecium; F, portion of twig with female inflorescence axillary to leaf scar; G, female flower at anthesis; H, opened female flower at anthesis; I, portion of older fruiting twig. (A from *van Niel 5419*, B–E from *S. 18011*, F–H from *SAN 63191*, I from *SAN 17438*.)

(eds.) *l.c.* 221. **Lectotype:** *Beccari 1242*, Borneo, Sarawak (FI Acc. 7625, fruit). **Synonym:** *Myristica carnosa* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 87.

Tree up to 10 m tall. **Bark** often flaky or shallowly fissured; inner bark yellowish, thin; sap watery, clear. **Sapwood** whitish. **Twigs** *pale brown*, *terete*, *stout*, *neither distinctly lined nor ridged*, *towards apex 3–10(–16) mm diameter*, initially tomentose with hairs *c.* 0.1 mm long, glabrescent; older twigs striate, with a tendency to flake, *drying pale*, *contrasting with the dark brown drying petioles*; lenticels not conspicuous. Leaf buds 9–13 × 2–3 mm, tomentose with hairs *c.* 0.1 mm long. **Leaves** *distichous*, *chartaceous to coriaceous*, *upper surface drying bright dark brown*, *bullate (with a finely wrinkled-granulate structure)*, *lower surface brown*, *early glabrescent* (glabrous), *without blackish dots*; *elliptic-oblong to oblong*, *13–35 × 5–11 cm*, base attenuate; midrib flat above; lateral veins 13–18 pairs, flat above; *petiole 1–1.6 cm long*. **Inflorescences** tomentose with hairs up to 0.1 mm long; bract 4–10 mm long, caducous; males many-flowered, 3–4-times branched, 6–17 × 5–14 cm, peduncle 10–30 mm long; females borne on older branches, many-flowered, 1–2 cm long, flowers clustered. **Flowers** glabrous; *perianth 3-lobed*; *pedicel not articulated at the base*. **Male flowers** in loose clusters of 3–9; pedicel 1–1.5 mm long; *buds subglobose*, *1.9–2.1 × 1.8–2 mm*; *perianth at anthesis clefts to 1/3–1/2*, lobes *c.* 0.2 mm thick, not collapsing on drying, glabrous; *androecium* subglobose, 1–1.2 × 1–1.3 mm, *circular in transverse section*; *anthers* 9–11, *largerly connate*, completely sessile (free apices more or less absent), curved, at apex concealing the 0.2–0.4 mm deep apical cavity of the column; androphore narrow, 0.2–0.5 mm long, completely hidden by the anthers. **Female flowers:** *buds ellipsoid*, *c. 3.5 mm long*. **Fruits** 2–11 per infructescence, ellipsoid, *1.6–2 × 1.2–1.5 cm*, glabrous, drying brown with a finely granular surface; dry pericarp *c.* 1.5 mm thick; stalk 1–2 mm long; *perianth not persistent*. **Seeds** *ellipsoid*; aril orange.

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei and W Kalimantan).

Ecology. In *kerangas* forest, peatswamp forest, and *Agathis-Casuarina* forest, on white sandy soils, up to 100 m altitude. Flowering mainly in July–November; fruiting throughout the year.

6. **Horsfieldia crassifolia** (Hook. *f.* & Thomson) Warb.

(Latin, *crassus* = thick, *folium* = leaf; thick-leaved)

Monogr. Myrist. (1897) 323; Gamble *l.c.* 217; Merrill *l.c.* (1921) 268; Ridley *l.c.* 59; Masamune *l.c.* 301; J. Sinclair *l.c.* 16 (1958) 386, *l.c.* (1975) 23; Anderson *l.c.* 264; W.J. de Wilde *l.c.* (1985) 219; Whitmore, Tantra & Sutisna *l.c.* 263; Turner *l.c.* 358; Coode *et al.* (eds.) *l.c.* 221; Argent *et al.* (eds.) *l.c.* 448. **Basionym:** *Myristica crassifolia* Hook. *f.* & Thomson, Fl. Ind. (1855) 160. **Type:** *Griffith 4350*, Peninsular Malaysia (K). **Synonyms:** *M. paludicola* King *l.c.* 328; *H. fulva* (King) Warb. var. *paludicola* (King) Warb. *l.c.* (1897) 299.

Tree up to 25 m tall; stilt roots or low buttresses occasionally occur. **Bark** greyish, fissured, flaking into small rectangular scales. **Twigs** terete, *grey-brown and not much contrasting with the drying petioles*, towards apex 2–6(–8) mm diameter, yellow-brown to rusty woolly tomentose with hairs 0.2–0.5 mm long, glabrescent; bark striate, not flaky, lenticels distinct or not. Leaf buds 7–12 × 2–3 mm, pubescent with hairs 0.2–0.5 mm long. **Leaves** *distichous*, *coriaceous*, *upper surface drying dull (greenish) brown*, *lower surface thinly covered with subpersistent tomentum consisting of interwoven or spaced stellate scales c. 0.1 mm high*, *or glabrescent with distinct hair scars*, *with scattered blackish dots or streaks*; elliptic to oblong, 10–20(–28) × 3.5–7(–10) cm, base rounded to attenuate, apex rounded to subacute or rarely emarginate; midrib flattish above; lateral veins 11–16 pairs, flattish or sunken above; intercostal venation indistinct or invisible on both surfaces; petiole 0.9–2(–3) cm long. **Inflorescences** late-glabrescent or with persistent, rather dense, woolly tomentum consisting of dendroid hairs 0.2–0.5 mm long; bract 2–5(–7) mm long, caducous; males 3–5-times branched, broadly paniculate, 6–20 × 4–15 cm, peduncle 4–20 mm long; females 3–14 cm long. **Flowers** in loose clusters of 2–7, glabrous; *perianth 2-lobed*; *pedicel at base not articulated*. **Male flowers:** pedicel 0.3–1 mm long; buds globose or slightly transversely ellipsoid, (0.8–)1–1.3 × 1–1.5 mm; perianth at anthesis clefts to 1/3–1/2 (–2/3); androecium globose or more or less transversely ellipsoid, 0.4–0.5 × 0.5–0.8 mm; *anthers (3–)4–6*, *well-spaced*, *with broad connectives* (giving the androecium an angular appearance), free for almost the upper half or more; *androphore 0.2(–0.3) mm long*, slender. **Female flowers:** pedicel 1.5–2.5 mm long; buds 2–3 × 2–2.5 mm; perianth at anthesis clefts for 1/5–1/3 only; ovary glabrous, 1.5 × 1.2–1.5 mm. **Fruits** (1–)2–10 per infructescence, *ovoid to obovoid*, 1.5–2.2 × 1.2–1.8 cm, base and apex rounded, glabrous, sometimes with few lenticel-like tubercles; dry pericarp 1.5–2 mm thick; stalk 2–5(–7) mm long; perianth persistent. **Seeds** *ellipsoid*.

Vernacular name. Sarawak—*kumpang paya* (Iban).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. Mostly in marshy habitats, such as freshwater and peatswamp forests, on sandy soils, up to 200 m altitude. Flowering and fruiting throughout the year.

7. **Horsfieldia discolor** W.J. de Wilde

(Latin, *discolor* = of different colour; the two sides of the leaf blade)

Blumea 32 (1987) 469; Whitmore, Tantra & Sutisna *l.c.* 264. **Type:** *Kostermans 7414*, Borneo, E Kalimantan (holotype L; isotype BO).

Tree up to 18 m tall. **Bark** red-brown, light brown or blackish, smooth or fissured; inner bark red-brown or orange-brown, 5–7 mm thick; sap clear pink or red. **Sapwood** white or yellow with reddish streaks. **Twigs** *stout*, *terete*, *not ridged in between the bases of the petioles*, *towards apex (2–)3–4 mm diameter*, tomentose with scale-like stellate hairs c. 0.1 mm long, soon glabrescent; *bark pale coloured*, *contrasting with the dark brown drying petiole*, lower down coarsely striate, not cracked or flaky; *lenticels* absent or few or many, *inconspicuous*. *Leaf buds* slender, *c. 10 × 2 mm*, pubescent with scale-like hairs up to 0.1 mm long. **Leaves** *distichous*, *thinly chartaceous*, *extremely brittle when dry*, *upper surface not scabrous*, *not finely wrinkled*, *drying olivaceous-brown*, *lower surface early glabrescent (glabrous)*, *drying bright brown*, *without blackish dots*; oblong to oblong-lanceolate, *(9–)13–18 × (3.5–)4–7.5 cm*, base attenuate; midrib flat, slender; lateral veins 10–13 pairs, flat above, slender and inconspicuous beneath; *petiole* drying dark brown, *1–1.5 cm long*. **Male** and **female inflorescences** and **flowers** not known, but judging from the flower of related species, the *perianth presumably subglobose*, *3–4-lobed*; *androecium subcircular in cross section*. **Infructescences** coarse, short, little or not branched, 1.5–3.5 cm long, early glabrescent, bearing 1–2(–3) fruits. **Fruits** subglobose to ellipsoid, *5.5–8(–9)* × *4–6.5 cm*, glabrous, drying blackish brown, wrinkled and without or with a few wart-like lenticels; dry pericarp 10–20 mm thick; stalk 2–5 mm long; *perianth not persistent*. **Seeds** ellipsoid-oblong, 4–4.5 × 3 cm; aril bright orange to red, laciniate at apex for 1/4–1/5.

Distribution. Endemic to Borneo (Sabah, Sarawak and E Kalimantan).

Ecology. In hill mixed dipterocarp forest on loamy soils over sandstone, at 700–900 m altitude; also in alluvial (riverbank) forest and *kerangas* forest on sandy soils. Fruiting in March, June–July, and November.

8. **Horsfieldia disticha** W.J. de Wilde

(Latin, *distichus* = in two opposite rows; the leaves)

Gard. Bull. Sing. 39 (1986) 10, *l.c.* (1987) 467; Anderson *l.c.* 264; Whitmore, Tantra & Sutisna *l.c.* 264; Coode *et al.* (eds.) *l.c.* 222. **Type:** *Sinclair (& Kadim) 10453*, Borneo, Brunei, Andulau FR (holotype L; isotypes A, B, BM, E, K, NY, SAR, SING).

Tree up to 20 m tall. **Bark** with longitudinal, shallow furrows. **Twigs** *solid*, slender, *terete to faintly angular*, *not ridged*, *towards apex 2–3(–4) mm diameter*, *on drying dark grey-brown* or dull reddish brown, *not contrasting with the drying petiole*, *initially tomentose with dull rusty hairs 0.2–0.3 mm long*, *early glabrescent*; *bark coarsely longitudinally cracked*, lenticels sparse but distinct. *Leaf buds* slender, *c. 10 × 2 mm*, *pubescent with hairs 0.2–0.3 mm long*. **Leaves** *distichous*, *chartaceous*, *upper surface drying olivaceous*, *not bullate*, *not scabrous*, glabrous, *lower surface* pale chocolate, *glabrous*, *without blackish dots*; oblong-lanceolate, *8–13.5 × 2.5–3.5 cm*, *base more or less rounded to short-attenuate*, *apex long acute-acuminate*; *midrib raised above*, *at base narrower than 3 mm*; *lateral veins 9–13 pairs*, *raised above*; *petiole 1–1.5 cm long*. **Male** and **female flowers** not seen but *perianth 3-lobed* as judged from the perianth scars on the fruits. **Infructscences** 3–6 × 2–4 cm, borne on older branches behind the leaves, bearing 3–6 fruits. **Fruits** *ovoid-ellipsoid*, *2.8–3.2 × 2.1–2.5 cm*, glabrous, drying dark brown, not tubercled or lenticellate; *pericarp woody when dry*, *8–10 mm thick*; stalk 10–15 mm long; *perianth not persistent*. **Seeds** *ellipsoid*.

Distribution. Endemic to Borneo (Brunei; can be expected to occur in Sabah and/or Sarawak).

Ecology. In lowland mixed dipterocarp forest. Fruiting in August.

9. **Horsfieldia endertii** W.J. de Wilde

(F.H. Endert, 1891–1953, sometime forest officer in Indonesia)

Gard. Bull. Sing. 39 (1986) 24; Whitmore, Tantra & Sutisna *l.c.* 264. **Type:** *Endert 3996*, Borneo, E Kalimantan, W Kutai (holotype L; isotypes A, BO, K).

Tree up to 40 m tall. **Bark** cracked to finely fissured, brown-black to dark brown; inner bark reddish. **Sapwood** whitish. **Twigs** *solid*, *terete*, *not ridged*, *towards apex 2.5–4(–8) mm diameter*, *drying dark brown*, *not contrasting with the drying petiole*, *at first pubescent with rough*, *deep-rusty hairs 0.3–0.6 mm long*, glabrescent; bark coarsely striate, with conspicuous lenticels, older bark tending or not to flake. *Leaf buds* 10–20 × 3–4 mm, *pubescent with hairs 0.3–0.6 mm long*. **Leaves** *distichous*, *thickly coriaceous*, *brittle on drying*, *upper surface drying olivaceous or brown*, *not scabrous*, *lower surface* drying brown, not much contrasting with the upper surface, *without blackish dots or streaks but usually with conspicuous golden hair scars*, *glabrous*; elliptic to lanceolate, *8–17(–26) × 3–6(–10) cm*, base rounded to short-attenuate, *apex rounded to subacute*; midrib broad and raised above, towards the base late-glabrescent on both sides; *lateral veins* 8–15 pairs, *sunken or slightly raised above*; intercostal venation generally invisible on both surfaces; *petiole 0.6–1.6 cm long*. **Inflorescences** *rusty pubescent with shaggy hairs 0.5–1 mm long*; bract 3–7 mm long, pubescent, caducous; males 2- or 3-times branched, few-flowered, (1.5–)3–10 × (1–)2–5 cm, peduncle 5–20 mm long, flowers in clusters of (1–)2–6; females few-flowered, 2–4 cm long. **Flowers:** *perianth* glabrous, *3–4-lobed*; *pedicel* puberulous with minute hairs 0.1–0.3 mm long, especially in the lower half, *at base not articulated*. **Male flowers:** *pedicel 2–3 mm long*; *buds obovoid to ellipsoid*, *2.5–3.5 × 2–2.5 mm*, apex and base rounded; perianth at anthesis clefts to 1/3–1/2, slightly collapsing on drying; *androecium* more or less sessile, truncate-ellipsoid, *2–2.8 × 1.4–1.6 mm*, *subtriangular in cross section*; *anthers* (10–)12–14, sessile, 2–2.8 mm long, *almost entirely connate*, *more or less curved*; column solid except for the narrow apical cavity of 1/5–1/3 deep; androphore narrow, 0.1–0.3 mm long, hidden by the anthers. **Female flowers** glabrous; *buds 2.5–3 × 2–2.5 mm*; perianth at anthesis clefts to 1/3–1/2; ovary *c.* 2 × 1.5 mm, glabrous; *pedicel 1.5–2 mm long*, towards the base pubescent with hairs *c.* 0.2 mm long. **Fruits** 1–4(–8) per infructescence, ellipsoid, *3–4.2 × 1.6–2.4 cm*, base rounded, apex rounded to somewhat acute, glabrous; dry pericarp 2–4 mm thick; stalk 3–5 mm long; *perianth not persistent*. **Seeds** ellipsoid; aril bright orange.

Vernacular name. Sarawak—*binarak* (Murut).

Distribution. Endemic to Borneo (Sabah, Sarawak and E Kalimantan).

Ecology. In lower to upper montane forests on ridges and wind-swept crests, on sandy, black or brownish soils, at 1200–2100 m altitude. Flowering and fruiting throughout the year.

10. **Horsfieldia fragillima** Airy Shaw Fig. 4.

(Latin, *fragilis* = fragile; the dry leaves)

Kew Bull. 1939, no. 10 (1940) 542; Masamune *l.c.* 301; J. Sinclair *l.c.* (1975) 31; Anderson *l.c.* 264; W.J. de Wilde *l.c.* (1986) 29; Whitmore, Tantra & Sutisna *l.c.* 264; Coode *et al.* (eds.) *l.c.* 222; Argent *et al.* (eds.) *l.c.* 448. **Type:** *Richards 2602*, Borneo, Sarawak, Marudi district, Mt. Dulit (holotype K; isotypes A, SING).

Tree up to 30 m tall. **Bark** chocolate, reddish brown, or blackish brown, slightly fissured, mostly with few flakes, or scaly, or peeling off in thin flakes; inner bark *c.* 3 mm thick, pale pink or reddish to yellowish. **Sapwood** soft, whitish, yellow-pink or pinkish white.

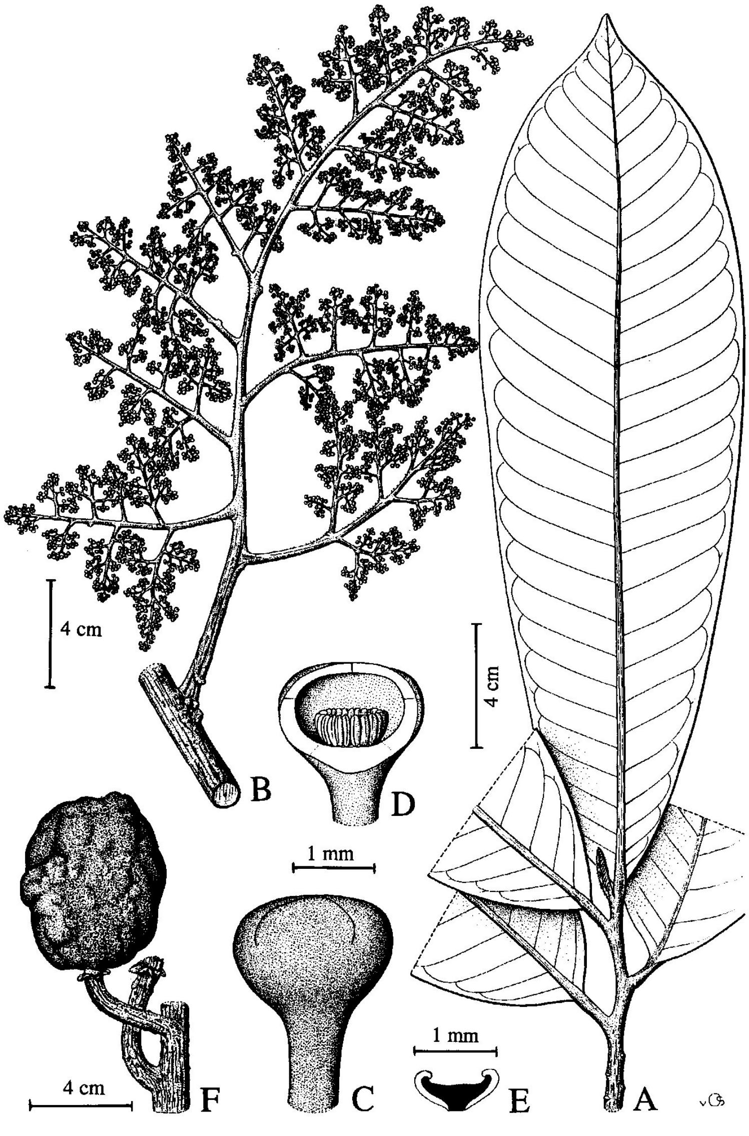

Fig. 4. *Horsfieldia fragillima.* A, leafy twig; B, portion of older twig with male inflorescence axillary to leaf scar; C, mature male flower bud; D, opened mature male flower bud showing the androecium; E, schematic diagram of longitudinal section of androecium; F, portion of twig with infructescence showing mature fruit with persistent perianth. (A–E from *S. 34358*, F from *S. 16985*.)

Twigs *solid*, *terete or subterete*, *not ridged*, *drying brown*, *not contrasting with the drying petiole*, *towards apex 2.5–7(–15) mm diameter*, *tomentose with hairs c. 0.3 mm long*, early glabrescent; *bark* with conspicuous lenticels, *with a slight tendency to slightly flaking*. *Leaf buds 12–20 × 3–5 mm*, *pubescent with hairs c. 0.2 mm long*. **Leaves** *distichous or sometimes partly in 3 rows*, *not bunched at the top of the twigs*; *membranous to coriaceous*, *upper surface drying olivaceous or brown*, *not bullate*, *not scabrous*, *lower surface early glabrescent*, often with some minute tomentum remaining at the base of the midrib, *without blackish dots*, *without golden hair scars*; oblong to oblong-lanceolate, *20–45 × 6.5–12(–15.5) cm*, base rounded to attenuate; midrib raised above; *lateral veins 20–30 pairs*, *raised above*; *petiole 0.4–1.3(–2) cm long*. **Inflorescences** *tomentose with hairs 0.2 mm long or more*; bract up to 12 mm, caducous; males large, to 5-times branched, 15–30 × 10–20 cm, peduncle 25–60 mm long; females 6–13 cm long. **Flowers** glabrous; *perianth 3–4-lobed*. **Male flowers:** *pedicel 1–2 mm long*, *at base not articulated*; *buds depressed globose*, *1.4–2 × 2–2.5 mm*; *perianth at anthesis clefts to nearly 1/2*; *androecium sessile*, *almost saucer-shaped*, broadly depressed in the centre, *0.5–1 × 1–1.5 mm*; anthers 7–9, sessile, *more or less curved*, *almost entirely connate*; column with broad apical cavity to 1/2 deep; *androphore minute*. **Female flowers:** *buds 4–5 mm long*. **Fruits** up to 8 per infructescence, broadly ellipsoid, *6–8 × 4–6 cm*, glabrous; dry pericarp 10–20 mm thick; *perianth persistent for a long time*; stalk 2–4 mm long. **Seeds** ellipsoid; aril reddish orange.

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In primary lowland mixed dipterocarp forest, on hill slopes and flat seasonally flooded lands, up to 400 m altitude, most commonly recorded from sandy, leached clayey loam over sandstone, and sandy clay soils, often along or near streams. Flowering in February–May; fruiting throughout the year.

Uses. Fruits recorded as edible, very acid and resinous.

11. **Horsfieldia gracilis** W.J. de Wilde

(Latin, *gracilis* = slender; the twigs)

Gard. Bull. Sing. 38 (1985) 211, Blumea 41 (1996) 377; Whitmore, Tantra & Sutisna *l.c.* 264; Coode *et al.* (eds.) *l.c.* 222. **Type:** *Ilias S. 16604*, Borneo, Sarawak, Miri district (holotype L; isotypes K, SAR).

Tree *c.* 5 m tall. **Twigs** *terete*, *slender*, *towards apex 1.5–2.5 mm diameter*, initially tomentose with rough hairs 0.3–0.5 mm long, late-glabrescent; bark not cracked or flaky; lenticels inconspicuous or absent. *Leaf buds 6–7 × 1.5 mm*, *pubescent with persistent rough hairs 0.3–0.5 mm long*. **Leaves** *distichous*, *membranous*, *upper surface* drying olivaceous, glabrous, *not bullate*, *not scabrous*, *lower surface tomentose with subpersistent scattered rough hairs 0.3(–0.5) mm long or subglabrous*, *without blackish dots or streaks*; oblong-lanceolate, *12–21 × 4–6(–6.5) cm*, base subattenuate; *midrib* raised above, *with persistent tomentum beneath*; *lateral veins 12–17 pairs*, slightly raised to flat above; *intercostal venation indistinct above*; *petiole 0.8–1.4 cm long*, late-glabrescent. **Inflorescences:** males paniculate, 3–5 cm long; females 1–1.5 cm long. **Male flowers:** *pedicel c.* 0.5 mm long, *articulated at the base*; *buds depressed globose*, *c. 0.6 × 1 mm*; *perianth glabrous*, *3–4-lobed*, *at anthesis clefts to slightly over halfway*; androecium depressed globose, *c.* 0.5 × 0.9–1 mm; anthers 16–18, central column with small cavity at the apex. **Female flowers:** *buds c. 2 × 1.5 mm*. **Fruits** 1–3 per infructescence, ellipsoid, *1.4–1.5 × 1–1.1 cm*, *glabrous*, drying dark brown, finely granulate; dry pericarp 0.5–1 mm thick; stalk 1–1.5 mm long; *perianth persistent*. **Seeds** ellipsoid.

Distribution. Endemic to Borneo (Sarawak, Miri district; also in Brunei).

Ecology. In primary lowland mixed dipterocarp forest.

12. **Horsfieldia grandis** (Hook. *f.*) Warb.

(Latin, *grandis* = large; the large leaves)

Monogr. Myrist. (1897) 301; Gamble *l.c.* 211; Merrill *l.c.* (1921) 268; Ridley *l.c.* 56; Masamune *l.c.* 301; J. Sinclair *l.c.* (1958) 400, *l.c.* (1975) 48; Anderson *l.c.* 264; W.J. de Wilde *l.c.* (1985) 203; Whitmore, Tantra & Sutisna *l.c.* 264; Turner *l.c.* 358; Coode *et al.* (eds.) *l.c.* 222; Argent *et al.* (eds.) *l.c.* 448. **Basionym:** *Myristica grandis* Hook. *f.*, Trans. Linn. Soc. 23 (1860) 157. **Type:** *Low s.n.*, Borneo, Sabah (holotype K). **Synonym:** *M. rubiginosa* King *l.c.* 302.

Tree up to 25 m tall. **Bark** smooth, fissured, scaly, flaky, or cracked, strips *c.* 1 mm thick, *c.* 1 cm wide, hard and thin; inner bark 2–3 mm thick, slash rich red-brown; sap reddish, watery. **Sapwood** soft, whitish to yellowish pink, heartwood pale brown. **Twigs** rather stout, *terete*, towards apex (3–)4–10 mm diameter, initially densely tomentose with rough hairs 1–1.5 mm long, late-glabrescent, *not ridged*; bark sometimes cracked and flaky; lenticels not conspicuous. *Leaf buds 7–15 mm long*, pubescent. **Leaves** *distichous*, membranous or chartaceous, surface somewhat bullate, *upper surface* drying olivaceous or brown, largely with rough persistent tomentum, sometimes glabrescent, *always scabrous by rough persistent hair bases*, *lower surface rough tomentose with persistent hairs 1–2 mm long*, *without dark dots*; elliptic-oblong to oblong-oblanceolate, *12–40 × 5–20 cm*, base attenuate or subcordate; midrib raised above; lateral veins (8–)10–16(–19) pairs, usually sunken above; *petiole 0.6–1.5 cm long*, pubescent. **Inflorescences** pubescent with hairs 1.5–3 mm long; bract (1–)3–12 mm long, caducous; males 6–25 × 2.5–10(–15) cm, peduncle up to 12 mm long; females 1.5–5 cm long. **Flowers:** *perianth 3–4-lobed*, glabrous; *pedicel* glabrous, *at base not articulated*. **Male flowers:** pedicel (0.5–)1–2 mm long; buds depressed globose, 1.2–1.8(–2) mm diameter; perianth at anthesis clefts to 1/3–1/2; androecium depressed globose, 0.5–1 × 0.8–1.5 mm; anthers 8–10, almost completely sessile, incurved towards the apex; column with cavity *c.* 0.2 mm deep; androphore narrow, 0.2–0.4 mm long. **Female flowers:** buds broadly ellipsoid, 2–3.2 mm long. **Fruits** 2–10 per infructescence, more or less clustered, obovoid-ellipsoid, *1–1.4 × 0.8–1.1 cm*, glabrous; dry pericarp *c.* 1.5 mm thick; stalk *c.* 1 mm long; *perianth persistent*. **Seeds** almost globose, 0.8–1 cm diameter; aril orange.

Vernacular name. Sabah—*darah-darah* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. Under- or middle-storey trees, rarely reaching timber size, of primary and secondary lowland to hill forests on sandy and clay soils, up to 600 m altitude. Flowering and fruiting throughout the year.

13. **Horsfieldia irya** (Gaertn.) Warb.

(*irya*, a local plant name from Sri Lanka)

Monogr. Myrist. (1897) 317; Gamble *l.c.* 215; Merrill *l.c.* (1921) 268; Ridley *l.c.* 58; Masamune *l.c.* 301; J. Sinclair *l.c.* (1958) 382, *l.c.* (1975) 61; Backer & Bakhuizen *f. l.c.* 138; Whitmore, *l.c.* 326; Anderson *l.c.* 264; W.J. de Wilde *l.c.* (1985) 55; Corner *l.c.* 564; Whitmore, Tantra & Sutisna *l.c.* 264; Turner *l.c.* 358; Coode *et al.* (eds.) *l.c.* 222; Argent *et al.* (eds.) *l.c.* 448. **Basionym:** *Myristica irya* Gaertn., Fruct. 1 (1788) 195. **Type:** *Gaertner's drawing*, *plant from Ceylon*. **Synonyms:** *M. javanica* Blume, Bijdr. (1825) 576; *M. spherocarpa* Wall., Pl. As. Rar. (1830) 79; *M. irya* (Gaertn.) Warb. var. *wallichii* King *l.c.* 309; *H. lemanniana* (A. DC.) Warb. *l.c.* (1897) 326; *H. subglobosa* (Miq.) Warb. *l.c.* (1897) 328; *M. vrieseana* Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1865) 49; *M. irya* (Gaertn.) Warb. var. *longifolia* King *l.c.* 309; *H. labillardieri* Warb. *l.c.* (1897) 283; *H. acuminata* Merr., Phil. J. Sc. 17, 1920 (1921) 253; *H. nunu* Kanehira, Bot. Mag. Tokyo 46 (1932) 451; *H. amklaal* Kanehira, Bot. Mag. Tokyo 47 (1933) 670; *H. congestiflora* A.C. Smith, J. Arn. Arb. 22 (1941) 64.

Tree up to 40 m tall; bole often fluted, with prop-roots or buttresses up to 3 m high, 2 m out, 10 cm thick, or without buttresses. **Bark** smooth, fissured or cracked, flaky or peeling off in small pieces; inner bark cream or whitish, up to 7 mm thick. **Sapwood** cream or whitish, ochreish, straw-coloured, or pinkish; heartwood absent or only slightly darker, pale brown. **Twigs** terete, usually thinly ridged, towards apex (2–)3–10 mm diameter, initially tomentose with minute, grey or rusty hairs 0.1–0.5 mm long, glabrescent; bark often blackish, not flaky; lenticels usually conspicuous. Leaf buds 10(–15) mm long, pubescent with hairs 0.1–0.5(–1) mm long. **Leaves** *distichous*, often curved towards the tip, *membranous*, *upper surface drying greenish brown to blackish*, *usually with irregular whitish blotches of unknown origin*, *lower surface early glabrescent*, *without dark dots*; elliptic-oblong to lanceolate, 10–30(–35) × 3–7(–9) cm, base rounded or attenuate; midrib flattish above; lateral veins 10–20 pairs, flattish above; petiole 0.7–1.6 cm long. **Inflorescences** pubescent with hairs 0.1–0.5(–1) mm long, persistent or glabrescent; bract 1.5–4 mm long, caducous; males 4–18 × 3–7(–10) cm, peduncle 5–45 mm long; females 2–6(–8) cm long. **Flowers** largely glabrous; *perianth 2-lobed*; *pedicel at base not articulated*. **Male flowers:** pedicel 0.1–1.5 mm long; buds subglobose, laterally somewhat compressed or not, 1–1.3(–1.5) × (1–)1.2–1.5 mm; perianth at anthesis clefts to 1/2–2/3; androecium transversely broadened, 0.8–1.2 × 1–1.5 mm; *anthers* 6–9, *for the greater part connate*, *forming a saucer-shaped column*, at apex free for 0.2–0.3 mm; *androphore* cup-shaped, *tapered*. **Female flowers:** buds ellipsoid, 1.5–2.3 mm long. **Fruits** 2–8 per infructescence, *globose*, 1.5–2.2 cm diameter, glabrous, drying dark brown or blackish; dry pericarp 1–2 mm thick; stalk 5–10 mm long; perianth not persistent. **Seeds** *globose*; aril orange, orange-red or red.

Vernacular names. Sabah—*lempoyang paya* (preferred name). Sarawak—*penarahan pianggu* (Malay).

Distribution. Widespread from Sri Lanka through Malesia to the Solomon Islands. Throughout Borneo.

Ecology. In primary and old secondary forests. Most frequent in coastal or riverine habitats on alluvial, sandy, loamy, or clayey soils, up to 450 m altitude.

14. **Horsfieldia laticostata** (J. Sinclair) W.J. de Wilde

(Latin, *latus* = broad, *costa* = midrib; the broad midrib)

Gard. Bull. Sing. 39 (1986) 15; Whitmore, Tantra & Sutisna *l.c.* 264. **Basionym:** *H. brachiata* (King) Warb. var. *laticostata* J. Sinclair *l.c.* (1975) 12; Anderson *l.c.* 263. **Type:** *Sinclair 10265*, Borneo, Sarawak, Serian district, Sg. Sabal Tapang (holotype K; isotypes A, E, L, SAR, SING).

Tree up to 35 m tall. **Bark** hard, fissured or flaky, brown to reddish brown; inner bark reddish, laminated. **Sapwood** whitish. **Twigs** *stout*, *solid*, *not ridged*, *terete*, *towards apex 3–8(–15) mm diameter*, *grey-brown to blackish on drying*, *not contrasting with the drying petiole*, *tomentose with hairs 0.1–0.4 mm long*, early glabrescent; *lower down coarsely striate*, almost flaky, lenticels usually distinct. *Leaf buds 15–23 × 3–5 mm*, *tomentose with hairs 0.1–0.4 mm long*. **Leaves** *distichous*, *thinly to thickly coriaceous*, *upper surface drying dull olivaceous*, glabrous, *not bullate*, *not scabrous*, *lower surface chocolate*, *contrasting with the upper surface*, *without blackish dots*, *early glabrescent*; obovate-oblong to oblong, *(15–)20–33 × 6–12 cm*, base attenuate, *apex shortly acute-acuminate*; *midrib raised above*, *towards the base flattish and conspicuously broadened to 3–4(–5) mm wide at the transition to the petiole*, glabrous or with remnants of tomentum towards the base; *lateral veins* 11–20(–24) pairs, *raised above but towards the blade margin sunken*; intercostal venation distinct or not; *petiole* stout, *0.6–1.5 cm long*, *0.15–0.4(–0.8) cm diameter*. **Inflorescences** *sparsely pubescent with hairs 0.2–0.4 mm long*; bract 2–8 mm, caducous; *males stout*, *4–5-times branched*, *many-flowered*, *10–25 × 8–22 cm*, axis towards the base 3–4 mm diameter, peduncle 3–35 mm long; females 3–7 cm long, few-flowered. **Flowers** in clusters of up to 10; *perianth 3-lobed*, glabrous; *pedicel* sometimes with few hairs at the base, 0.1–0.2 mm long, *distinctly articulated*. **Male flowers:** *pedicel (1–)1.5(–2) mm long*; *buds broadly obovoid*, *1.3–1.5 mm diameter*; base rounded or sometimes more or less attenuate; *perianth at anthesis clefts to c. halfway*, not collapsing on drying; *androecium* broadly obovoid, *c.* 0.7 mm diameter, *triangular in transverse section*; *anthers* 6, *suberect*, acutish, *mutually largely free*, *c.* 0.3(–0.4) mm long; androphore more or less tapering, *c.* 0.3(–0.4) mm long. **Female flowers** glabrous or with few minute hairs *c.* 0.1 mm long; buds broadly ellipsoid, *c.* 2.5 mm diameter; perianth at anthesis clefts to *c.* 1/3, lobes 0.3–0.4 mm thick; ovary *c.* 1.5 mm long, glabrous; pedicel 0.5–1 mm long. **Fruits** 1–4 per infructescence, ellipsoid, 2.8–4 × 2.2–2.5 cm, apex and base rounded, glabrous; dry pericarp 4–5 mm thick; stalk 2–4 mm long; *perianth not persistent*. **Seeds** ellipsoid, shining white, spotted.

Vernacular name. Sabah—*pisau-pisau* (Kedayan).

Distribution. Endemic to Borneo (Sabah, Sarawak and Kalimantan).

Ecology. In primary peatswamp and *kerangas* forests, on sandy acid, nutrient-poor, waterlogged soils, up to 400 m altitude. Flowering and fruiting throughout the year.

15. **Horsfieldia macilenta** W.J. de Wilde

(Latin, *macilentus* = meagre; the delicate twigs)

Gard. Bull. Sing. 39 (1986) 13; Whitmore, Tantra & Sutisna *l.c.* 264; Turner *l.c.* 358. **Type:** *Aban SAN 37103*, Borneo, Sabah (holotype L; isotype SAN).

Tree up to 17 m tall. **Bark** whitish or greenish yellow; inner bark red; sap red. **Twigs** *slender*, *terete*, *not ridged*, *drying brown*, *not contrasting with the drying petiole*, *towards apex 1–3 mm diameter*, *tomentose with woolly stellate-dendroid hairs (0.2–)0.5 mm long*, late-glabrescent; *older bark not cracked*; lenticels inconspicuous. *Leaf buds 6–8 × 1.5 mm*, *tomentose with woolly stellate-dendroid hairs (0.2–)0.5 mm long*. **Leaves** *distichous*, *membranous*, *upper surface drying dull olivaceous*, *not bullate*, *not scabrous*, glabrous, *lower surface early glabrescent* except the midrib and the very base, *without dark dots and streaks*; oblong to oblong-lanceolate, *10–18(–27) × 3–6.5 cm*, *base rounded to short-attenuate*, *apex acute-acuminate*; *midrib raised above*, *at base narrow*, *on lower surface late-glabrescent*; *lateral veins 10–15(–18) pairs*, *distinctly raised above*; *petiole 1–1.5 cm long*, *0.1–0.15(–0.2) cm diameter*, *tomentose with woolly stellate-dendroid hairs (0.2–) 0.5 mm long*, late-glabrescent. **Inflorescences** *sparsely woolly pubescent with stellate-dendroid hairs c. (0.2–)0.5 mm long*; bract 2–5 mm long, caducous; males many-flowered, 2- or 3(–4)-times branched, *4–9(–10) × 3–5(–7) cm*, peduncle 3–12 mm long; females similar, or shorter. **Flowers** glabrous or sometimes with a few minute hairs less than 0.1 mm long towards the base of the pedicel; *perianth 3-lobed*; *pedicel* glabrous or sparsely pubescent in the lower portion with hairs up to 0.1 mm long, *articulated at the base*. **Male flowers** in clusters of 5–8; pedicel (0.8–)1(–1.3) mm long; *buds depressed globose*, *0.7–1.2 × 1–1.2 mm*; *perianth at anthesis clefts to nearly 1/2*, lobes 0.2–0.3 mm thick; *androecium* subglobose, 0.4–0.5 × 0.5–0.7 mm, *in transverse section more or less triangular*; *anthers* 5–7, *suberect*, 0.3–0.4 mm long, *the upper half mutually free*; column largely hollow; androphore tapering, 0.2–0.3 mm long. **Female flowers:** buds subglobose, *c.* 1.5 mm diameter. **Fruits** 2 or 3 together in a short infructescence 2–3 cm long, glabrous, ellipsoid, *2.2–2.4 × 1.5–1.6 cm*, base contracted into a narrowed portion; dry pericarp *c.* 2 mm thick, drying brown, not or sparingly tubercled; stalk *c.* 5 mm long; *perianth not persistent*. **Seeds** ellipsoid.

Distribution. Sumatra, Peninsular Malaysia and Borneo (Sabah and Sarawak).

Ecology. In primary lowland mixed dipterocarp forest and swamp forest, up to 200 m altitude. Flowering in June–November.

16. **Horsfieldia montana** Airy Shaw

(Latin, *montanus* = growing in the mountain)

Kew Bull. 1939, no. 10 (1940) 542; Masamune *l.c.* 301; Anderson *l.c.* 265; W.J. de Wilde *l.c.* (1986) 35; Whitmore, Tantra & Sutisna *l.c.* 265; Coode *et al.* (eds.) *l.c.* 222. **Type:** *Richards* (*Native Collector*) *2509*, Borneo, Sarawak, Belaga district, Dulit Range (holotype K; isotype SING).

Tree up to 24 m tall. **Bark** finely and shallowly fissured, or sometimes flaky, chocolate, red-brown, dark brown or dark grey; inner bark pale yellowish, reddish, or brownish; sap red, watery. **Sapwood** pale orange or whitish. **Twigs** *solid*, *terete or faintly angular*, towards apex 1.5–4(–7) mm diameter, *drying grey-brown to dark brown*, *not contrasting with the drying petiole*, *tomentose with shaggy hairs 0.2–1 mm long*, glabrescent; lenticels inconspicuous or absent; bark flaky or not. *Leaf buds 5–10 mm long*, *tomentose with hairs 0.2–1 mm long*. **Leaves** *distichous*, *chartaceous to coriaceous*, *upper surface* glabrous except the midrib which is late-glabrescent towards the base, *drying blackish*, *not bullate*, *not scabrous*, *lower surface glabrous*, drying chocolate-brown, not much contrasting with the upper surface, *without blackish dots or conspicuous golden hair scars*; elliptic to elliptic-oblong, *4–14 × 2–6 cm*, base short-attenuate, *apex rounded to subacute*; midrib raised above; *lateral veins* 6–11 pairs, *flattish to raised above*; *petiole 0.5–1.6 cm long*, late-glabrescents. **Inflorescences** on older branches behind the leaves, either *sparsely pubescent with hairs 0.2–0.4 mm long*, *or densely pubescent with shaggy hairs 0.5–1 mm long*; bract 2.5–6 mm long, caducous; *males 4–12(–16) × 3–10 cm*, peduncle 5–20 mm long; females 2–6 cm long. **Flowers** glabrous; *perianth 3–4-lobed*; *pedicel in males not articulated at the base*, *in females more or less distinctly articulated*. **Male flowers:** *pedicel 1–1.5 mm long*; *buds subglobose*, *(1.2–)1.4–2 mm diameter*; *perianth at anthesis clefts to 1/3 to nearly 1/2*, not or slightly collapsing on drying, lobes (0.2–) 0.3 mm thick; *androecium (sub)sessile*, *depressed globose*, *(0.5–)0.6–1.1 × 0.8–1.1 mm*; *anthers* (8–)9–11, *more or less curved*, *almost entirely connate*, free apices up to 0.1 mm long; *column with shallow apical cavity*; *androphore* narrow, *0.3–0.5 mm long*, *largerly hidden by the anthers*. **Female flowers:** *buds* ellipsoid-obovoid, *c. 2 mm long*; ovary glabrous. **Fruits** 2–9 per infructescence, ellipsoid, *2–2.7 × 1.3–1.7 cm*, base more or less contracted toward the stalk, glabrous, drying brown; pericarp 1.5–2 mm thick; stalk 2–4 mm long, at base more or less articulated; *perianth not persistent*. **Seeds** ellipsoid.

Distribution. Endemic to Borneo (Sabah, Sarawak and Brunei).

Ecology. In crest forest, *kerangas* forest on ridges, montane mossy forest, and *Agathis* forest, on black soils or sandy soils, at (800–)1300–2000 m altitude. Flowering and fruiting throughout the year.

17. **Horsfieldia motleyi** Warb.

(James D. Motley, ?–1859, engineer and plant collector, mainly in Borneo)

Monogr. Myrist. (1897) 304; Merrill *l.c.* (1921) 268; Masamune *l.c.* 301; J. Sinclair *l.c.* (1975) 81; Anderson *l.c.* 265; W.J. de Wilde *l.c.* (1985) 209; Whitmore, Tantra & Sutisna *l.c.* 265; Argent *et al.* (eds.) *l.c.* 452. **Type:** *Motley 355*, Borneo, Kalimantan, Banjarmasin (holotype K; isotype CGE). **Synonyms:** *Myristica motleyi* (Warb.) Boerl. *l.c.* 85; *H. macrobotrys* Merr. *l.c.* (1929) 76.

Tree up to 25 m tall; bole sometimes with steep buttresses up to 5 m high, *c.* 30 cm out, *c.* 10 cm thick. **Bark** usually distinctly fissured, often scaly, strips 3–4 cm wide, up to 10 cm thick, dark brown, chocolate, or red-brown; inner bark 10–12 mm thick, undulate in cross section, dark brown or brown-red, laminated; sap red, watery or sometimes sticky, appearing fast. **Sapwood** whitish, reddish white; heartwood reddish or pinkish or brown. **Twigs** *terete*, towards apex (2.5–)3–5(–10) mm diameter; at first rusty tomentose with hairs 0.5(–1) mm long, late-glabrescent; lenticels not conspicuous; older twigs not flaky. *Leaf buds 15–20 mm long*, pubescent with hairs *c.* 0.5 mm long. **Leaves** *distichous*, *membranous*, *surface not scabrous*, *upper surface* drying olivaceous to brown, glabrous, *not bullate*, *lower surface rather densely tomentose with persistent hairs 0.3–1 mm long*, *without blackish dots or streaks*; elliptic to oblong, *9–27 × 4–12 cm*, base rounded to attenuate, apex somewhat obtuse to acute-acuminate; midrib flattish above, sometimes late-glabrescent; lateral veins 9–21 pairs, above late-glabrescent, usually sunken; *petiole 1.3–2.2 cm long*, late-glabrescent. **Inflorescences** yellow-brown to rusty pubescent with hairs 0.5–1 mm long; bract 2–5 mm long, caducous; males 12–20 × 10–14 cm, peduncle 20–40 mm long; females 3–6(–10) cm long. **Flowers:** *perianth 3-lobed*; *pedicel at base not articulated*; *persistent pubescence comprising hairs 0.1–0.3 mm long*. **Male flowers:** pedicel 1–1.5 mm long; *buds subglobose or broadly obovoid*, *0.8–1 × 0.7–1 mm*; *perianth at anthesis clefts to about halfway*; androecium (including androphore) depressed obovoid, 0.5–0.7 × (0.3–)0.5–0.6 mm; anthers 5, almost sessile, 0.2–0.4 mm long, column with apical cavity to *c.* 1/10 deep; androphore conspicuous, about as long as the anthers. **Female flowers** pubescent; buds *c.* 2.4 × 1.8–2 mm; ovary glabrous. **Fruits** 5–15 per infructescence, broadly ellipsoid, *1.9–2.3 × 1.6–1.8 cm*, glabrous; dry pericarp *c.* 3 mm thick; stalk 2–4 mm long; *perianth not persistent*. **Seeds** ellipsoid.

Distribution. Endemic to Borneo (Sabah, Sarawak and Kalimantan).

Ecology. In various types of primary and disturbed mixed dipterocarp forests on well-drained sandy or sandy clay soils, often on ridge tops, up to 750 m altitude. Flowering and fruiting throughout the year.

18. **Horsfieldia nervosa** W.J. de Wilde

(Latin, *nervosus* = nerved; the conspicuously many-nerved leaves)

Gard. Bull. Sing. 39 (1986) 16; Whitmore, Tantra & Sutisna *l.c.* 265. **Type:** *Ilias & Ashton S. 16652*, Borneo, Sarawak (holotype L; isotypes A, K, SAN, SAR).

Tree up to 16 m tall; buttresses thin, up to 35 cm tall. **Bark** pale ochre and brown mottled, smooth. **Twigs** *solid*, *terete* or towards apex subterete, *not ridged*, *drying grey-brown*, *not contrasting with the drying petiole*, *3.5–6(–8) mm diameter*, initially tomentose with hairs 0.3–0.6 mm long, glabrescent; lenticels inconspicuous; bark flaky or not. *Leaf buds 16–20 mm long*, *tomentose with hairs c. 0.5 mm long*. **Leaves** *distichous*, *thinly coriaceous*, *upper surface not bullate*, *not scabrous*, *drying olivaceous*, midrib and lateral veins late-glabrescent, *lower surface chocolate*, *contrasting in colour with the upper surface*, *without blackish dots*, *early glabrescent with the hairs c. 0.5 mm long often remaining on veins and midrib*; oblong, *16–28 × 5.5–9 cm*, *base short-attenuate to rounded*; *midrib* slender, *at transition with petiole c. 1.5 mm wide*, *distinctly raised above*, late-glabrescent; *lateral veins 16–19 pairs*, *conspicuously raised above*, glabrescent; intercostal venation laxly reticulate, indistinct or hardly visible; *petiole 1.5–2.2 cm long*, *0.3–0.5 cm diameter*, late-glabrescent. **Inflorescences** on the older branches behind the leaves, *pubescent with shaggy hairs up to 0.6 mm long*; bract caducous; *males c. 10 × 10 cm*, peduncle 10–20 mm long; females *c.* 4 cm long. **Flowers:** *perianth 3-lobed*, *glabrous*; *pedicel towards the base pubescent with hairs 0.1–0.2 mm long*, *articulated*. **Male flowers:** *pedicel c. 1.5 mm long*; *buds globose*, *c. 1.2 mm diameter*; *perianth at anthesis clefts to nearly 1/2*, not collapsing on drying; *androecium* (including androphore) more or less broadly obovoid, 0.6–0.7 × 0.6 mm, *triquetrous in transverse section*; *anthers* 5 or 6, *at least the upper half free*, *more or less erect*; column with deep cavity at the apex; androphore more or less tapering to the base, *c.* 0.3 mm long. **Female flowers:** buds subglobose, *c.* 2.5 mm diameter; perianth subglabrous with some scattered hairs *c.* 0.1 mm long toward the base, at anthesis clefts to slightly over 1/3; ovary broadly ovoid, *c.* 1.5 mm diameter, glabrous, stigma *c.* 0.3 × 0.6 mm, 2-lobed. **Fruits** not seen.

Distribution. Endemic to Borneo (Sarawak, known by two collections only).

Ecology. In primary mixed dipterocarp forest on yellow podsolic soils, up to 100 m altitude. Flowering in November.

19. **Horsfieldia obscura** W.J. de Wilde

(Latin, *obscurus* = indistinct; a species difficult to recognize)

Gard. Bull. Sing. 39 (1986) 42, Blumea 32 (1987) 468; Whitmore, Tantra & Sutisna *l.c.* 265. **Type:** *Kostermans 13773*, Borneo, E Kalimantan (holotype L; isotypes A, BO, K, NY, P, PNH, SING).

Tree up to 20 m tall. **Bark** red-brown, rough, *c.* 5 mm thick, peeling off irregularly in strips; inner bark *c.* 10 mm thick, red to brown-red; sap red. **Sapwood** reddish to brown-red. **Twigs** *solid*, *terete*, *not ridged*, *drying dark brown*, *not contrasting with the drying petiole*, towards apex 2–3(–4) mm diameter, *initially tomentose with hairs up to 0.1 mm long*, early glabrescent; bark not flaky; lenticels moderately large. *Leaf buds* slender, 7–10 mm long, *pubescent with hairs up to 0.1 mm long*. **Leaves** *distichous*, *membranous*, *not bullate*, *not scabrous*, *upper surface drying dark brown*, *lower surface pale brown*, *glabrous*, *without blackish dots*; elliptic-oblong to oblong, *10–15 × 4–7 cm*, base short-attenuate, apex shortly acute-acuminate; midrib flat to slightly raised above; *lateral veins* 10–13 pairs, *very thin and flat above*; intercostal venation laxly reticulate, very faint on both surfaces; *petiole 1–1.5 cm long*, glabrous. **Inflorescences** *sparsely pubescent with hairs up to 0.1 mm long*; bract caducous; males 7–10 × 5–8 cm, 3–4-times branched, many-flowered, peduncle (2–)6–12 mm long; females *c.* 3.5 cm long, stout. **Flowers** glabrous; *perianth 3–4-lobed*; *pedicel* subglabrous, *sometimes faintly articulated*. **Male flowers** in clusters of 3–5; pedicel 1–2 mm long; *buds subglobose*, *2–2.2 × 2–2.3 mm*; *perianth at anthesis clefts to 2/3–3/4(–4/5)*, *lobes at base 0.2–0.3 mm thick*; *androecium depressed globose-ovoid*, apex narrowly, base broadly rounded, *c. 1 × 1–1.2 mm*, *subcircular in transverse section*; *anthers* 8–10, almost sessile, *more or less curved*, *almost entirely connate*, the free apices up to 0.1(–0.2) mm long; apical cavity of column 0.1–0.2 mm deep; *androphore c. 0.2 mm long*. **Fruits** 2 or 3 on a stout infructescence *c.* 3.5 cm long, broadly ellipsoid, 5–5.5 × 3.5–4 cm, glabrous, drying dark brown, with few small tubercles; dry pericarp 7–10 mm thick; perianth not persistent. **Seeds** ellipsoid; aril red.

Distribution. Borneo (Sarawak and E Kalimantan) and the Philippines (Palawan).

Ecology. In ridge forest on limestone and coral limestone, and lowland mixed dipterocarp forest on yellow sandy soils, at 150–730 m altitude. Flowering in August and November; fruiting in May.

20. **Horsfieldia obtusa** W.J. de Wilde

(Latin, *obtusus* = blunt; the blunt or rounded leaf tip)

Gard. Bull. Sing. 39 (1986) 9; Whitmore, Tantra & Sutisna *l.c.* 265. **Type:** *Native Collector BS 821*, Borneo, Sarawak (L).

Tree. **Twigs** *solid*, *terete or faintly angular*, *not ridged*, towards apex 2.5–4(–6) mm diameter, *drying dark brown*, *not contrasting with the drying petiole*, initially dark rusty tomentose with hairs 0.2–0.4 mm long, *late-glabrescent*; bark finely cracked; lenticels inconspicuous. *Leaf buds c.* 12 mm long, *densely dark rusty pubescent with hairs 0.2–0.4 mm long*. **Leaves** *distichous*, thinly coriaceous, *not bullate*, *not scabrous*, *upper surface* glabrous (except the midrib), *drying olivaceous*, *lower surface early glabrescent*, drying purplish brown, *with yellowish enlarged hair scars*, *without blackish dots*; oblong, *8–10 × 3–3.5 cm*, *base attenuate*, *apex rounded*; *midrib at base narrow*, raised above, late-glabrescent; *lateral veins c. 10 pairs*, *flat or slightly raised above*; intercostal venation laxly reticulate, not or hardly visible; *petiole c. 1 cm long*, late-glabrescent. **Inflorescences** on older branches behind the leaves, *densely rusty pubescent with hairs 0.2–0.4(–0.5) mm long*; bract caducous; males 5–9 × 3–5 cm, 3-times branched, many-flowered; peduncle 3–10 mm long. **Male flowers:** *pedicel* glabrous, 1–1.5 mm long, *at base articulated*; *buds subglobose*, *1.3–1.5 × 1.5–1.6 mm*; *perianth* glabrous, *3–4-lobed*, *at anthesis clefts to nearly 1/2*, more or less woody, brittle, not collapsing on drying; *androecium* (including androphore) broadly obovoid, *c.* 0.8 × 1 mm, *in transverse section 3–4-angled*; *anthers 9 or 10*, *more or less erect*, *free in the upper half*; androphore more or less tapering, *c.* 0.3 mm long; apical cavity of column distinct. **Female flowers** and **fruits** not known.

Distribution. Endemic to Borneo. Only known by the type specimens from Sarawak, precise locality not indicated.

21. **Horsfieldia oligocarpa** Warb.

(Greek, *oligos* = few, *karpos* = fruit; with few fruits)

Monogr. Myrist. (1897) 354; Merrill *l.c.* (1921) 268; Masamune *l.c.* 301; W.J. de Wilde *l.c.* (1986) 22; Whitmore, Tantra & Sutisna *l.c.* 265; Coode *et al.* (eds.) *l.c.* 222. **Lectotype** (de Wilde, 1986): *Beccari 2066*, Borneo, Sarawak, Kuching district, Mt. Matang (hololectotype FI acc. no. 7620; isolectotypes K, P). **Synonyms:** *Myristica oligocarpa* (Warb.) Boerl. *l.c.* 87; *H. polyspherula* (Hook. *f.*) J. Sinclair var. *oligocarpa* (Warb.) J. Sinclair *l.c.* (1975) 104.

Tree up to 20 m tall. **Bark** grey, dark brown to reddish brown, broadly fissured; inner bark pink-brown, soft, *c.* 10 mm thick; sap red. **Sapwood** pink-yellow. **Twigs** *terete*, *towards apex 2–3(–4) mm diameter*, glabrescent, *drying pale yellowish or whitish-brown*, *contrasting with the dark colour of the drying petiole*; lenticels small, distinct; older bark not flaky. *Leaf buds 7–10 mm long*, pubescent with hairs *c.* 0.2 mm long, the tomentum early shed in the form of small crust-like pieces. **Leaves** *distichous*, *chartaceous*, *not bullate*, *not scabrous*, *upper surface* glabrous, *drying grey-greenish*, dull, *lower surface* generally *chocolate-brown*, *contrasting with the upper surface*, *glabrous*, *without blackish dots*; elliptic-oblong to oblong, *7–16 × 2.5–6 cm*, base attenuate, apex acute-acuminate; midrib raised above, glabrous; lateral veins 8–11(–15) pairs, raised above; intercostal venation indistinct on both surfaces; *petiole 0.6–1.2 cm long*, drying blackish brown.

Inflorescences sparsely pubescent with hairs 0.2–0.3 mm long, sometimes glabrescent; bract caducous; males 3–6 × 1.5–4 cm, 2–3-times branched, peduncle 5–10 mm long, few-flowered; females not seen, according to the infructescences *c.* 1.5–4 cm long. **Male flowers:** *pedicel* glabrous, 1–1.5 mm long, *at base articulated*; *buds globose to broadly obovoid*, *1–1.7 mm diameter*; *perianth* glabrous, *3-lobed*, *at anthesis clefts to nearly 1/2*, more or less coriaceous, not collapsing on drying; *androecium* (including androphore) more or less obovoid, *c.* 1 mm across, *triangular in transverse section*; *anthers* 6 or 7, *largely mutually free*; androphore tapering, *c.* 0.5 mm long. **Female flowers** not seen. **Fruits** 1–4 per infructescence, ellipsoid, 1.8–2.7 × 1.4–1.9 cm, glabrous, drying dark brown, hardly lenticellate; pericarp 2–3 mm thick; stalk 2–5 mm long; *perianth not persistent*. **Seeds** ellipsoid.

Distribution. Endemic to Borneo (Sarawak and Brunei).

Ecology. In peatswamp and heath forests on nutrient-poor soils (white sand, white podsolic sand, yellow sand, sandstone 'terraces', and peat), up to 100 m altitude. Flowering in June and August; fruiting in August–October.

22. **Horsfieldia pallidicaula** W.J. de Wilde

(Latin, *pallidus* = pale; *caulis* = stem; with pale stem)

Gard. Bull. Sing. 38 (1985) 191; Whitmore, Tantra & Sutisna *l.c.* 265. **Type:** *Jacobs 5413*, Borneo, Sarawak, Baram district (holotype L; isotypes CANB, G, K, SAR, SING).

Tree up to 20 m tall. **Bark** smooth, slightly flaky or fissured, dark grey. **Twigs** *terete*, *not ridged*, *towards apex 2–10 mm diameter*, *drying pale whitish or greyish brown*, *contrasting with the blackish colour of the drying petiole*, initially tomentose with hairs 0.1–0.3 mm long, early glabrescent; *bark slightly flaky or not*; lenticels inconspicuous. *Leaf buds 7–10 mm long*, *pubescent with hairs (0.1–)0.2(–0.3) mm long*. **Leaves** *either in 2, 3 or 5 rows*, *not bunched at the top of twigs*, *membranous*, *not bullate*, *not scabrous*, *upper surface drying dark brown*, *lower surface paler*, *without blackish dots*, *early glabrescent*; oblong to oblong-lanceolate, *10–30 × 4–9.5 cm*, base long-attenuate, apex acute-acuminate; midrib flat or slightly raised above, glabrous; lateral veins 10–18 pairs, flat or slightly raised above; intercostal venation laxly reticulate, indistinct above; *petiole 1–2.5 cm long*, often greyish and flaky in the lower half. **Inflorescences** glabrescent, *tomentum* weak, *comprising hairs 0.1–0.2 mm long*; bract 1–3 mm long, caducous; males 3–9 × 2.5–7 cm, (2–)3-times branched, many-flowered, peduncle up to 7 mm long (hence inflorescences often also branched from near the base); females few-flowered, 1–3 cm long. **Flowers:** *perianth 3–4-lobed*, in females sometimes 2-lobed, glabrous; *pedicel* glabrous, *at base not articulated*. **Male flowers:** pedicel 1–2 mm long, slender; *buds globose or broadly obovoid*, *1.5–2(–2.2) mm diameter*; perianth at anthesis clefts to 1/3 to 1/2, not or slightly collapsing on drying; *androecium* short-ellipsoid or depressed globose, 0.8–1.2 × 0.8–1.2 mm, *circular in cross-section*; anthers 8–10, sessile; column with narrow apical cavity 0.1–0.2 mm deep; androphore up to 0.2 mm long. **Female flowers:** *buds* broadly ellipsoid or subglobose, *2.5–3 × 2.5 mm*. **Fruits** 1–5 per infructescence, broadly ellipsoid, *1.5–4 × 1–3 cm*, glabrous, drying blackish, finely granulate, sometimes tuberculate; pericarp various; stalk 1–3 mm long; *perianth persistent* (always?). **Seeds** ellipsoid.

Distribution. Endemic to Borneo (Sabah, Sarawak and Kalimantan). Three varieties are known.

Key to varieties

1. Fruits 3.7–4 × 2.7–3 cm; pericarp 6–8(–10) mm thick. Leaves (23–)25–30 cm long.........
   var. **macrocarya** W.J. de Wilde
   (Greek, *makro* = large, *karyon* = nut; with large nut)
   l.c. (1985) 193. Type: *Ding Hou 474*, Borneo, Sarawak (L).
   Endemic to Borneo (Sarawak).
   Fruits 1.5–2.2 × 1–1.8 cm; pericarp 1–3 mm thick. Leaves up to 25 cm long.................2

2. Fruits 1.5–1.7 × 1–1.2 cm; pericarp 1–1.5 mm thick. Leaves up to 23 cm long..................
   var. **microcarya** (J. Sinclair) W.J. de Wilde
   (Greek, *mikro* = small, *karyon* = nut; with small nut)
   l.c. (1985) 193. Type: *Wood & Kapis SAN 16971*, Borneo, Sabah (holotype: K; isotypes KEP, L, SAN, SING). Synonym: *H. bracteosa* Henderson var. *microcarya* J. Sinclair *l.c.* (1975) 20.
   Endemic to Borneo (W Sabah and E Kalimantan). In lowland mixed dipterocarp forest up to 100 m altitude. Fruiting in July.
   Fruits 2–2.2 × 1.8 cm; pericarp 2–3 mm thick. Leaves up to 25 cm long........................
   var. **pallidicaula**
   W.J. de Wilde *l.c.* (1985) 192.
   Endemic to Borneo (Sabah, Sarawak; possibly also in W Kalimantan). In primary lowland and hill mixed dipterocarp forests on sandstone, up to 700 m altitude. Flowering throughout the year; fruiting in June.

23. **Horsfieldia paucinervis** Warb.

(Latin, *pauci* = few, *nervium* = nerve; the few-nerved leaves)

Monogr. Myrist. (1897) 345; Merrill *l.c.* (1921) 268; Masamune *l.c.* 301; J. Sinclair *l.c.* (1975) 93; Anderson *l.c.* 265; W.J. de Wilde *l.c.* (1985) 212, *l.c.* (1996) 379; Whitmore, Tantra & Sutisna *l.c.* 265. **Type:** *Beccari 3279* (female flowers), Borneo, Sarawak (FI). **Synonym:** *Myristica paucinervis* (Warb.) Boerl. *l.c.* 87.

Tree up to 8 m tall. **Twigs** *terete*, *slender*, *towards apex 2–3 mm diameter*, initially reddish to yellow-brown tomentose with shaggy hairs 1.5–2 mm long, late-glabrescent; bark dark grey, not cracked; lenticels not conspicuous. Leaf buds 8–10 mm long, pubescent. **Leaves** *distichous*, *thinly chartaceous*, *surface not scabrous*, *not bullate*, *upper surface drying olivaceous*, glabrous, *lower surface thinly tomentose with persistent hairs 0.5–1 mm long*, *with blackish dots* (always?) *but without streaks*; elliptic to elliptic-oblong, *7–15 × 3–6.5 cm*, base rounded to attenuate, apex acute to acute-acuminate; midrib flat and indistinct above, late-glabrescent; *lateral veins 5–9(–11) pairs*, flat or sunken above; *petiole 0.6–1.2 cm long*, pubescent. **Inflorescences** pubescent with hairs (0.7–)1–2 mm long; bract caducous; males 5–9 × 3–5 cm, peduncle up to 15 mm long; females 4–6 cm long. **Flowers:** *perianth 3-lobed*, *glabrous*; *pedicel* glabrous, *at base not articulated*. **Male flowers:** *pedicel slender*, *0.5–1.5 mm long*; *buds subglobose*, *0.8–1 × 1–1.5 mm*; perianth at anthesis clefts to 1/3 to nearly 1/2; androecium small, more or less depressed globose, 0.3–0.5 × 0.4–0.8 mm, more or less circular in transverse section; anthers 4 or 5, sessile; apical cavity of column *c.* 1/5 deep; androphore 0.1–0.2 mm long. **Female flowers:** buds ovoid-globose, *c.* 2 mm diameter, *ovary glabrous*. **Fruits** (immature) *with persistent perianth*, *glabrous*, oblong, *c. 1 × 0.7 cm*; stalk *c.* 2 mm long.

Distribution. Endemic to Borneo (Sarawak).

Ecology. In coastal *kerangas* and secondary forests on eroded white sands, up to 50 m altitude. Flowering throughout the year.

24. **Horsfieldia penangiana** J. Sinclair
(of Penang, Peninsular Malaysia)

Gard. Bull. Sing. 16 (1958) 408, *l.c.* (1975) 94; W.J. de Wilde *l.c.* (1986) 52, *l.c.* (1996) 379; Turner *l.c.* 359. **Type:** *Curtis 2406*, Peninsular Malaysia, Penang (holotype SING; isotypes BM, K).

subsp. **obtusifolia** W.J. de Wilde
(Latin, *obtusus* = blunt, *folium* = leaf; with blunt leaf apex)

l.c. (1996) 379. **Type:** *Dayang Awa & Othman S. 47061*, Borneo, Sarawak (holotype L; isotypes K, SAR).

Tree up to 25 m tall. **Twigs** *solid*, *terete*, *slender*, *towards apex 1.5–2(–4) mm diameter*, *drying grey-brown to brown*, *not contrasting with the drying petiole*, *tomentose with hairs up to 0.1 mm long*, glabrescent; bark not flaky; lenticels small. *Leaf buds* slender, 6–9 mm long, *tomentose with very short hairs up to 0.1 mm long*. **Leaves** *distichous*, *membranous to thinly coriaceous*, *not bullate*, *not scabrous*, upper surface drying olivaceous to blackish brown, *lower surface early glabrescent*, *with scattered dark* (rarely pale) *brown dots*; elliptic-oblong to oblong, *6–14 (–17) × 2–4 cm*, *base attenuate*, *apex blunt or rounded*; midrib flattish to raised above; *lateral veins 8–11 pairs*, thin, flat and inconspicuous above; *petiole 0.8–1.3 cm long*, glabrescent. **Inflorescences** *with sparse tomentum comprising very short hairs c. 0.1 mm long*; bract 1.5–2.5 mm long, caducous; males 2–7 × 1.5–4.5 cm, peduncle 2–20 mm long; females 2–5 cm long. **Male flowers:** *pedicel* glabrous, *0.8–1.5(–2) mm long*, slender, *at base more or less articulated or not*; *buds subglobose*, more or less circular to faintly triangular in transverse section, *c. (1.5–)2 mm diameter*; *perianth 3-lobed*, glabrous, *at anthesis clefts to c. 1/3 to nearly halfway*; *androecium depressed globose*, *subcircular in transverse section*; *anthers 12(–15)*, sessile, *more or less curved*, *almost entirely connate*, free apices up to 0.3 mm long, slightly incurved; column with shallow cavity at the apex; androphore up to 0.1 mm long. **Fruits** 2–6 per infructescence, ovoid-ellipsoid, *c. 1.5 × 1 cm*, glabrous, without lenticel-like tubercles; *dry pericarp c. 1.5 mm thick*; stalk 3–4 mm long, at base articulated; perianth not persistent.

Distribution. Endemic to Borneo (Sarawak and E Kalimantan).

Ecology. In mixed dipterocarp forest on ridge tops and hills, at (50–)300–800 m altitude.

25. **Horsfieldia polyspherula** (Hook. *f. emend.* King) J. Sinclair

(Latin, *poly* = many; *sphaera* = globe or ball; flowers like many small balls)

Gard. Bull. Sing. 16 (1958) 422; *l.c.* (1975) 101 *p.p.* (for the type var. only); W.J. de Wilde *l.c.* (1986) 17, *l.c.* (1996) 381; Whitmore, Tantra & Sutisna *l.c.* 266; Coode *et al.* (eds.) *l.c.* 222. **Basionym:** *Myristica polyspherula* Hook. *f.*, Fl. Brit. Ind. 5 (1886) 108, *p.p.*; King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 312, *emend.* **Lectotype** (J. Sinclair, 1975)**:** *Griffith 4354*, Peninsular Malaysia (hololectotype K; isolectotypes BM, CAL, CGE, FI, G, P, U).

Tree up to 40 m tall, with or without buttresses. **Bark** shallowly boat-shaped fissured or flaky; inner bark yellow or pinkish, fibrous. **Wood** moderately soft, whitish yellow. **Twigs** *solid*, *not ridged*, *terete or subterete*, *towards apex 2–5(–13) mm diameter*, *drying grey-brown to blackish*, *not contrasting with the drying petiole*, tomentose with rusty, mealy, dendroid hairs 0.1–0.6 mm long, *late-glabrescent*; lenticels distinct or not; *bark striate*, *not cracked*. *Leaf buds* 6–17 mm long, *tomentose with hairs 0.1–0.6 mm long*. **Leaves** *distichous*, *thickly membranous or chartaceous*, *not bullate*, *not scabrous*, on drying usually brittle, *upper surface drying olivaceous or greenish brown*, the midrib glabrescent, *lower surface drying light brown or chocolate*, *usually much contrasting with the upper surface*, *without blackish dots*, *early glabrescent* but with the midrib often late-glabrescent; elliptic-oblong, ovate-oblong to oblong-lanceolate, *7–28 × 2.5–9 cm*, *base subrounded or attenuate*, *apex acute-acuminate*; *midrib raised above*, *at base narrow*; *lateral veins 6–15 pairs*, *distinctly raised above* except close to the leaf margin, glabrous; *petiole 0.6–1.5 cm long*, *0.15–0.3 cm diameter*, late-glabrescent. **Inflorescences** *sparsely to densely woolly pubescent with hairs c. 0.6 mm long*; bract 1.5–7 mm long, caducous; *males 4–15 × 3–12 cm*, peduncle 3–15 mm long; females smaller, up to 8 cm long. **Flowers:** *perianth 3-lobed*, glabrous or glabrescent; *pedicel* sometimes minutely pubescent towards the base, *articulated*. **Male flowers:** pedicel slender, 0.8–1.5(–2) mm long; *buds subglobose*, *1–1.8 mm diameter*, base rarely more or less tapering into the pedicel, glabrous; *perianth at anthesis clefts to 1/2–2/3*, not collapsing on drying; *androecium* (including androphore) more or less broadly obovoid, 0.5–0.8 × 0.6–1 mm, *usually sharply triangular in transverse section*; *anthers* (3–)4–7, *free at least in the upper half*, *more or less curved or suberect*, 0.3–0.5 mm long, apex somewhat acute; column bowl-shaped, passing into the tapering androphore of 0.2–0.4 mm long. **Female flowers** glabrous or sparingly pubescent with hairs *c.* 0.1 mm long; buds 2–3 mm across; ovary glabrous. **Fruits** 1–6 per infructescence, subglobose or ellipsoid, *1.9–6 × 1.4–5 cm*, base rounded or slightly attenuate, glabrous; dry pericarp 2–15 mm thick; stalk 1–4 mm long; *perianth not persistent*.

Distribution. Sumatra, Peninsular Malaysia, Borneo, and southern parts of the Philippines. A variable species, with three varieties, all occurring in Sabah and Sarawak.

Key to varieties

1. Fruits (3.5–)4–6 × 3–5 cm; pericarp (5–)8–15 mm thick. Leaves 9–20 × 3.5–7 cm; lateral veins (6–)9–15 pairs……………..……...…………...........................………………..
    var. **maxima** W.J. de Wilde
    (Latin, *maximus* = largest; referring to the fruit)
    l.c. (1986) 22; Whitmore, Tantra & Sutisna *l.c.* 266; Coode *et al.* (eds.) *l.c.* 223. Type: *Chai S. 36228*, Borneo, Sarawak (holotype L; isotype SAR).

Endemic to Borneo (Sabah, Sarawak, Brunei and E Kalimantan). In mixed dipterocarp forest and *Agathis* forest on sandy waterlogged soils, sandy loam or yellow clay-loam soils; also known from *kerangas* forest; up to 500 m altitude. Fruiting throughout the year.

Fruits up to 3.5 cm long; pericarp 2–5 mm thick. Leaves 7–28 × 2.5–9 cm; lateral veins 6–20 pairs.........………...……......……………2

2. Fruits (1.7–)1.9–2.5(–2.8) × 1.4–2 cm; pericarp 2–4 mm thick. Male flower buds 1–1.5 mm diameter; anthers (3 or 4)–7. Female flower buds 2–2.5 mm long. Leaves 7–19 × 2.5–6 cm; lateral veins 6–15 pairs. Terminal leaf buds covered with hairs (0.2–)0.3–0.6 mm long.........................……………………………………..…………

var. **polyspherula**

W.J. de Wilde *l.c.* (1986) 19; Whitmore, Tantra & Sutisna *l.c.* 266; Coode *et al.* (eds.) *l.c.* 223.

Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo, recorded from Sabah, Sarawak, Brunei and E Kalimantan. In lowland forest, most often on sandy soils; also in *Casuarina* forest (E Borneo), freshwater swamp forest, ridge-top forest, *kerangas* forest (Sarawak, rare); up to 900 m altitude. Flowering throughout the year, but most collections in June–September; fruiting throughout the year.

Fruits (2.5–)2.8–3.5 × 2.2–2.7 cm; pericarp 3–5 mm thick. Male flower buds 1.2–1.8 mm diameter; anthers 6 or 7. Female flower buds *c.* 3 mm long. Leaves 13–28 × 4.5–9 cm; lateral veins 11–15(–20?) pairs. Terminal leaf buds covered with hairs 0.1–0.4 mm long.......…………………………………......……………..………..

var. **sumatrana** (Miq.) W.J. de Wilde

(of Sumatra)

l.c. (1986) 20; Whitmore, Tantra & Sutisna *l.c.* 266; Turner *l.c.* 359; Coode *et al. l.c.* 223. Basionym: *Myristica glabra* Blume var. *sumatrana* Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1865) 49. Type: *Korthals s.n.*, W Sumatra (holotype L; isotypes A, K, U). Synonyms: *H. brachiata* (King) Warb. var. *sumatrana* (Miq.) J. Sinclair *l.c.* (1975) 13, *p.p.*; *M. collettiana* King, *l.c.* 312.

Sumatra, Peninsular Malaysia, Singapore, and Borneo. In lowland mixed dipterocarp forest, ridge forest, montane forest; also in heath and peatswamp forests, on sandy and sandy-loamy soils, 'red' soils, yellow clayey soils; up to 1100 m altitude. Flowering and fruiting throughout the year.

26. **Horsfieldia punctatifolia** J. Sinclair

(Latin, *punctatus* = dotted, *folium* = leaf; the punctate leaves)

Gard. Bull. Sing. 16 (1958) 413, *l.c.* (1975) 104; Whitmore *l.c.* 327; Anderson *l.c.* 265; W.J. de Wilde *l.c.* (1986) 54; Whitmore, Tantra & Sutisna *l.c.* 266; Turner *l.c.* 359; Coode *et al.* (eds.) *l.c.* 223; Argent *et al.* (eds.) *l.c.* 452. **Type:** *Sinclair SFN 40211* (= *Sinclair 7989*), Singapore (holotype SING; isotypes B, BO, DD, E, K, L, P).

Tree up to 30 m tall. **Bark** smooth but shallowly fissured or cracked, or brittle and scaly; inner bark pinkish to red; sap reddish, watery. **Sapwood** white, yellowish, or pinkish; heartwood dark brown. **Twigs** *solid*, *terete*, not ridged, *towards apex 2.5–4(–10) mm diameter*, *drying dark grey-brown*, *not contrasting with the drying petiole*, *early grey-*

brown tomentose with hairs up to 0.1 mm long, glabrescent; bark not flaky; lenticels present. *Leaf buds 8–12 mm long*, *pubescent with hairs up to 0.1 mm long*. **Leaves** *distichous*, *membranous*, *not bullate*, *not scabrous*, *upper surface drying olivaceous or brown*, *lower surface glabrous*, *with scattered blackish dots*; elliptic-oblong to oblong, *9–21 × 3–9 cm*, base attenuate, apex acute-acuminate; midrib flat or slightly raised above; *lateral veins11–16 pairs*, thin and flat above; *petiole 1–1.7 cm long*, glabrous. **Inflorescences** *sparsely pubescent with hairs up to 0.1 mm long or glabrescent*; bract 2–4 mm long, caducous; males 4–10 × 2–8 cm, peduncle 5–20 mm long; females 3–6 cm, fewer-flowered. **Flowers** glabrous; *perianth 3–4-lobed*; *pedicel* glabrous, *not articulated*. **Male flowers:** pedicel 1–2(–2.5) mm long, slender; *buds depressed globose*, *1.4–2 × 1.6–2.2 mm*; *perianth at anthesis clefts to 3/4–4/5*; *androecium* depressed, broadly ovoid, 0.6–0.7 × 1–1.5 mm, *subtriangular with rounded angles in cross section*, subsessile; *anthers* 7–9, more or less curved, almost entirely connate, free apices up to 0.1 mm long, concealing apical cavity of column up to 0.2 mm deep. **Female flowers:** buds ellipsoid, 2.8–3.5 mm long; ovary glabrous. **Fruits** 1–3 per infructescence, broadly ellipsoid, *(4.5–)5–8 × (3–)3.5–4.5 cm*, glabrous; *dry pericarp 10–20 mm thick*; stalks 4–6 mm long; perianth not persistent. **Seeds** ellipsoid; aril red.

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak, Brunei, C and E Kalimantan).

Ecology. In primary lowland and hill forests, swamp forest and *kerangas* forests, on a variety of soils including grey, brown, sandy clay, and sandstone- and dacite-derived soils, up to 1100 m altitude. Flowering and fruiting throughout the year.

27. **Horsfieldia reticulata** Warb.

(Latin, *reticulatus* = netted; the intercostal venation of the leaf)

Monogr. Myrist. (1897) 304; Merrill *l.c.* (1921) 268; Masamune *l.c.* 301; J. Sinclair *l.c.* (1975) 107; Anderson *l.c.* 265; W.J. de Wilde *l.c.* (1985) 218, *l.c.* (1996) 381; Whitmore, Tantra & Sutisna *l.c.* 266. **Type:** *Beccari 3475*, Borneo, Sarawak (holotype FI; isotype K). **Synonyms:** *Myristica reticutata* (Warb.) Boerl. *l.c.* 85; *H. affinis* W.J. de Wilde *l.c.* (1985) 217.

Tree up to 20 m tall. **Bark** rough, dark brown, lenticellate; inner bark red. **Twigs** *terete*, *not ridged*, *towards apex 2.5–6(–9) mm diameter*, tomentose with hairs 0.5–1 mm long, late-glabrescent; bark when old dark grey, cracked but not flaky; lenticels inconspicuous. Leaf buds 10–15 mm long, pubescent with hairs 0.5–1 mm long. **Leaves** *distichous*, *membranous or chartaceous*, *both surfaces not scabrous*, *sometimes bullate*, *upper surface drying brown*, glabrous, *lower surface sparsely tomentose with subpersistent*, *mixed sessile and dendroid hairs 0.5–1 mm long*, *without blackish dots or streaks*; elliptic-oblong to lanceolate, *18–35 × 4–11 cm*, base rounded to attenuate, apex acute-acuminate; midrib flattish or slightly raised above, often late-glabrescent; *lateral veins (9–)17–20 pairs*, slender, sunken or raised above; *petiole (0.7–)1.2–2 cm long*, pubescent. **Inflorescences** pubescent with shaggy hairs 0.5–2 mm long; bract 3–9 mm long, caducous; males 12–25 × 8–14 cm, peduncle 15–60 mm long. **Male flowers:** *pedicel* slender, 0.5–2 mm long, glabrous, *at base articulated*; *buds depressed globose*, *1.2–2 × 1.5–2(–2.5) mm*; *perianth glabrous*, *3–5-lobed*, *at anthesis clefts to 1/4–1/3*; androecium depressed globose, more or less circular in transverse section, 0.6–0.8 × 1–1.5 mm; anthers 10–12(–15), sessile;

apical cavity of column up to halfway deep; androphore 0.2–0.4 mm long, hidden or not by the anthers. **Female flowers** not seen. **Fruits** 4–7 per infructescence, ellipsoid, *2.3–2.7 × 1.7–2.1 cm*, *glabrous*, drying brown, pale wart-like tubercles present; dry pericarp 1.5–2 mm thick; stalk 3–4 mm long; *perianth persistent.* **Seeds** ellipsoid.

Distribution. Endemic to Borneo (Sarawak, Brunei and Kalimantan).

Ecology. In lowland and hill mixed dipterocarp forests on alluvial, sandy clay, and sandstone-derived soils, up to 600 m altitude. Flowering in May–November; fruiting in July.

28. **Horsfieldia ridleyana** (King) Warb.

(H.N. Ridley, 1855–1956, botanist and former Director of the Singapore Botanic Gardens)

Monogr. Myrist. (1897) 331; Gamble *l.c.* 221; Ridley *l.c.* 60; Burkill, EPMP 1, (1935) 1199; J. Sinclair *l.c.* (1958) 432, *l.c.* (1975) 108; W.J. de Wilde *l.c.* (1986) 7; Whitmore, Tantra & Sutisna *l.c.* 266; Turner *l.c.* 359; Coode *et al.* (eds.) *l.c.* 223. **Basionym:** *Myristica ridleyana* King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 311. **Syntypes:** *Scortechini s.n.* & *862*, Peninsular Malaysia, Perak (holotype CAL; isotypes BM, K, L).

Tree up to 25 m tall. **Bark** dark brown to red-brown, shallowly and rectangularly fissured, shallowly cracked, flaky or shallowly dippled and fissured; inner bark reddish, fibrous, laminated. **Sapwood** pale, whitish, or creamy pink. **Twigs** *solid*, *not ridged*, *terete or somewhat angular*, *towards apex 1.5–3.5(–5) mm diameter*, *drying dark brown and not contrasting with the drying petiole*, rusty tomentose with hairs 0.2–0.4 mm long, *early glabrescent*; lenticels either small and distinct, or absent; older bark not flaky. *Leaf buds* 6–14 mm long, *pubescent with hairs 0.2–0.5 mm long*. **Leaves** *distichous*, *thinly chartaceous to coriaceous*, *not bullate*, *not scabrous*, *upper surface glabrous*, *drying olivaceous or brown*, *lower surface glabrous*, *drying light reddish-brown*, sometimes contrasting with the upper surface, *without blackish dots*; elliptic-oblong to lanceolate, *5–15(–16) × 2–4.5 cm*, *base attenuate*, *apex acute to acute-acuminate*; *midrib at base narrow*, *flattish above*; *lateral veins 7–15 pairs, sunken to flattish above*, inconspicuous; *petiole 0.7–1.5 cm long*, early glabrescent. **Inflorescences** *sparsely pubescent with hairs 0.1–0.3 mm long*, or glabrescent; bract caducous; males 2–6 × 2–4 cm, peduncle (2–)5–15 mm long; females fewer-flowered, 1.5–4 cm long. **Flowers:** *perianth 3–4(rarely 2)-lobed*, glabrous; *pedicel* slender, glabrous, *at base articulated.* **Male flowers:** *pedicel 1–2 mm long*; *buds subglobose or short-ellipsoid*, *1–1.2 × 0.8–1.2(–1.3) mm*, base rounded or short-attenuate; *perianth at anthesis clefts to 1/3 to nearly 1/2*, not or slightly collapsing on drying; *androecium* (including androphore) broadly obovoid, 0.6–0.8 × 0.4–0.7 mm, *in transverse section 3–4-angular* (rarely more or less ellipsoid in flowers with 2-lobed perianth); *anthers 4–6*, *more or less erect*, *mutually almost free*, 0.3–0.4 mm long; androphore tapering. **Female flowers:** buds ellipsoid, 1.5–1.8 × 1.5 mm; ovary glabrous. **Fruits** 1–6 per infructescence, ellipsoid, 1.5–2 × 1–1.4 cm, glabrous; dry pericarp *c.* 1.5 mm thick; stalk 2–5 mm long; *perianth not persistent*. **Seeds** ellipsoid.

Distribution. Peninsular Malaysia and Borneo (Sabah, Sarawak and Brunei).

Ecology. Usually in forest on poor soils, e.g., heath forest (with *Dacrydium beccarii*), forest on quartzite-ridge, and forest on sandstone ridge with very shallow soils (together with *Gymnostoma*, *Tristaniopsis* and *Cotylelobium*), up to 1100 m altitude. Flowering in June–October; fruiting throughout the year.

29. **Horsfieldia rufo-lanata** Airy Shaw

(Latin, *rufus* = reddish; *lanatus* = woolly; the indumentum)

Kew Bull. 1939, no. 10 (1940) 440; Masamune *l.c.* 301; J. Sinclair *l.c.* (1975) 111; Anderson *l.c.* 265; W.J. de Wilde *l.c.* (1985) 216; Whitmore, Tantra & Sutisna *l.c.* 266. **Type:** *Richards 1667*, Borneo, Sarawak (holotype K; isotype SING).

Tree up to 17 m tall. **Twigs** *terete*, *not ridged*, *towards apex 3.5–5(–7) mm diameter*, initially tomentose with reddish brown hairs 1–1.5 mm long, late-glabrescent; bark dark brown, longitudinally cracked, not flaky; lenticels indistinct. Leaf buds 15–20 mm long, pubescent with hairs 1–1.5 mm long. **Leaves** *distichous*, *chartaceous*, *surface slightly or not bullate*, *not scabrous*, *upper surface drying olivaceous*, glabrous except the lateral veins, *lower surface densely or sparsely tomentose with hairs 0.3–1.5 mm long*, *without blackish dots*; elliptic to oblong, *10–23 × 5–10(–12) cm*, base nearly rounded to subattenuate, apex acute to acute-acuminate; midrib more or less raised above, late-glabrescent; *lateral veins 11–16 pairs*, *raised above*, *pubescent or late-glabrescent*; *intercostal venation indistinct above*; *petiole 1–1.6 cm long*, pubescent. **Inflorescences** woolly pubescent with shaggy hairs 2–3 mm long; bract 3–8 mm long; males 8–12 × 5–7 cm, peduncle 15–30 mm long; females few-flowered, *c.* 3 cm long. **Male flowers:** *pedicel* glabrous, 0.5–1 mm long, *at base indistinctly articulated*; *buds subglobose*, hardly or not depressed, *2–2.3 mm diameter*, rather firm; *perianth glabrous*, *3–4-lobed*, *at anthesis clefts to nearly 1/2*; androecium globose, *c.* 1.2 mm diameter, circular in transverse section; *anthers c. 15*, sessile; column broad, solid except for small apical cavity to 1/5 deep; androphore *c.* 0.2 mm long. **Female flowers** not known. **Fruits** 2–4 per infructescence, broadly ovoid-ellipsoid, *2–2.2 × 1.5–1.6 cm*, *glabrescent*, *remnants of minute hairs c. 0.1 mm long present at the base*; pericarp drying brown, without lenticels or tubercles, *c.* 2 mm thick; stalk 1–3 mm long; *perianth not persistent*.

Distribution. Endemic to Borneo (Sabah and Sarawak).

Ecology. In hill mixed dipterocarp forest on sandstone and lower montane forest, at 900–1400 m altitude. Flowering in June and September; fruiting in September.

30. **Horsfieldia sabulosa** J. Sinclair Fig. 5.

(Latin, *sabulosus* = growing in sandy places)

Gard. Bull. Sing. 27 (1974) 133; Anderson *l.c.* 265; W.J. de Wilde *l.c.* (1985) 185; Whitmore, Tantra & Sutisna *l.c.* 266; Coode *et al.* (eds.) *l.c.* 223. **Type:** *Sinclair & Kadim 10491*, Borneo, Brunei, Bt. Labi (holotype K; isotypes A, B, E, K, L, NY, SAR, SING).

Tree up to 37 m tall. **Bark** dark grey, longitudinally fissured; inner bark reddish brown, laminated, fibrous; sap red, copious. **Sapwood** soft, pinkish. **Twigs** stout, terete, with wart-like thickened markings of leaf scars, (3–)5–10(–20) mm diameter, *at first grey-*

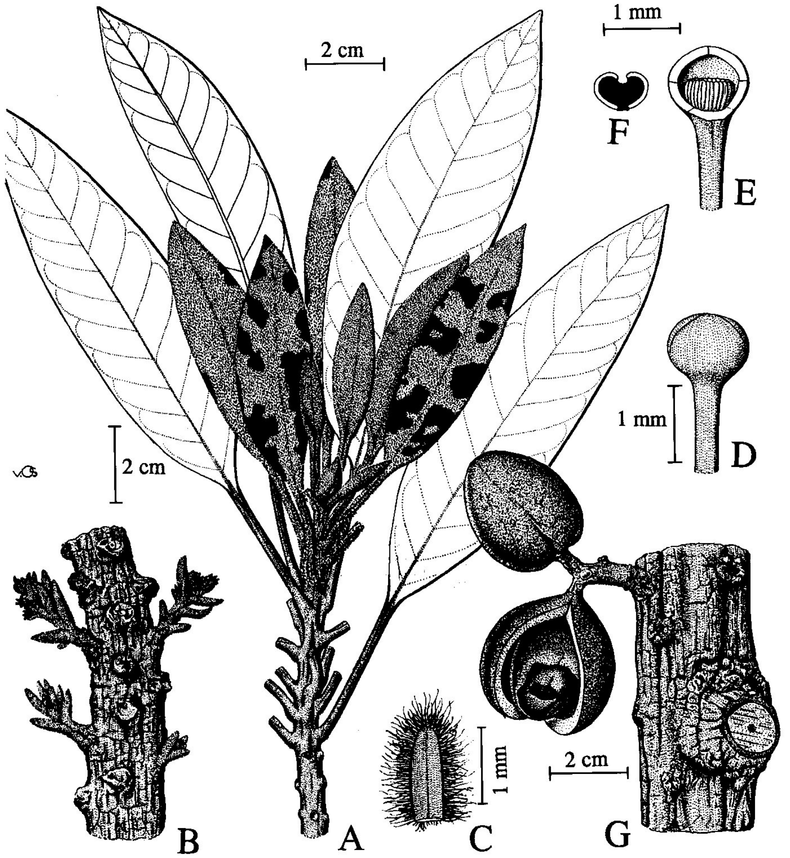

Fig. 5. *Horsfieldia sabulosa.* A, shoot apex with densely bunched, spirally arranged leaves; B, portion of older branch with young male inflorescences; C, smaller bract; D, immature male flower bud; E, longitudinal section of immature male flower bud; F, schematic diagram of longitudinal section of androecium; G, portion of older branch with infructescence. (A–F from *SAN 15146*, G from *BRUN 828.*)

brown to rusty tomentose with hairs 0.5–1(–1.5) mm long, late-glabrescent; *bark blackish*, cracked and *often conspicuously flaking*; lenticels inconspicuous. *Leaf buds stout*, *10–15 × (3–)4–5 mm*, *densely rusty pubescent with hairs 0.5–1.5 mm long*. **Leaves** *in 3–5 rows*, *generally bunched towards the apex of the twigs*, coriaceous, upper surface glabrous, more or less shining or not, drying olivaceous to brown, lower surface pale brown, glabrescent, with scattered blackish, roundish or sometimes elliptic or line-shaped dots; elliptic-oblong to sublanceolate, 9–21 × 2–6 cm, base attenuate, apex acute to short-acuminate; midrib flat above; lateral veins 12–20 pairs, flat above and below; *petiole 2.5–5 cm long*, *pubescent with hairs 0.5–1.5 mm long*, late-glabrescent. **Inflorescences** on older twigs of 15–20 mm thick behind the leaves, emerging from the axils of woody wart-like petiole scars on the older bark, densely pubescent with hairs 1–1.5 mm long; bract more or less boat-shaped, 4–15 mm long, outside pubescent with hairs 0.5–1.5 mm long, inside glabrous, late-caducous; males 10–13 × 5–6 cm, peduncle 15–25 mm long; females few-flowered, 3–5 cm long. **Flowers:** *perianth* glabrous, *3–4-lobed*; *pedicel* glabrous, *at base articulated*. **Male flowers:** pedicel 1.5(–2) mm long; buds (depressed)globose, 2 × 2–2.3 mm; perianth at anthesis clefts to (1/2–)1/3, not collapsing on drying; androecium subsessile, depressed globose, 1–1.2 × 1.7–1.8 mm; anthers 12 (–15), sessile; apical cavity of column shallow. **Female flowers:** ovary glabrous. **Fruits** 1–6 per infructescence, ovoid, 3–5 × 2.5–4 cm, glabrous, drying dark brown or blackish; dry pericarp hard, 5–8(–10) mm thick; stalk 2–8 mm long; perianth not persistent.

Distribution. Endemic to Borneo (Sabah, Sarawak and Brunei).

Ecology. In mixed dipterocarp forest on sandy or peaty soils, deep yellow sands, sandy loam, or heavy yellow clay soils; also in *Agathis* forest and ridge forest, up to 100 m altitude. Flowering in May–July; fruiting in May–December.

31. **Horsfieldia sessilifolia** W.J. de Wilde

(Latin, *sessilis* = without stalk; *folium* = leaf; with sessile leaves)

Gard. Bull. Sing. 38 (1985) 201; Whitmore, Tantra & Sutisna *l.c.* 267. **Type:** *Turkey S. 27808*, Borneo, Sarawak, Sibu district, Loba Kabang FR, Bt. Ingan (holotype L; isotypes K, SAR, SING).

Tree up to 30 m tall, 35 cm diameter, with stilt roots. **Twigs** stout, *terete*, *not ridged*, *towards apex 5–7(–10) mm diameter*; bark lower down glabrous, striate and densely set with conspicuous lenticels. **Leaves** *distichous*, chartaceous, *not scabrous*, upper surface glabrous, drying dark brown, *lower surface densely pubescent with interwoven hairs 0.1(–0.3) mm long, without dark brown dots*; oblong-lanceolate, more or less parallel-sided, *c. (25–)50(–70) × 14 cm*, base broadly rounded to subcordate, apex acute-acuminate; midrib flattish above; *lateral veins* 30(–35) pairs, *flat or slightly sunken above*; *petiole 0.2–0.3 cm long*, *or leaves sessile*. **Male inflorescences** not seen. **Female inflorescences** 4–5 × 3.5 cm, many-flowered; branches rusty pubescent with woolly hairs 0.3–0.5 mm long; peduncle *c.* 1 × 0.8 cm; bract *c.* 1 cm long, inside subglabrous, outside pubescent as the inflorescence, caducous. **Female flowers:** pedicel broad, *c.* 1 mm long, minutely pubescent; buds obovoid-ellipsoid, stout, 4.5–5 × 4–4.5 mm; *perianth 3-lobed*, coriaceous, pubescent with hairs *c.* 0.1 mm long in the lower half, at anthesis clefts to 1/8–1/10 only, lobes *c.* 0.5 mm thick; ovary ovoid, subglabrous. **Fruits** not seen.

Vernacular name. Sarawak—*kumpang tembaga* (Malay, Iban).

Distribution. Endemic to Borneo (Sarawak; known only by the type specimens).

Ecology. In lowland mixed swamp forest, below 100 m altitude. Flowering in June.

32. **Horsfieldia splendida** W.J. de Wilde Fig. 6.

(Latin, *splendens* = beautiful)

Gard. Bull. Sing. 38 (1985) 213; Whitmore, Tantra & Sutisna *l.c.* 267. **Type:** *Othman S. 33723*, Borneo, Sarawak (holotype L; isotypes SAN, SAR).

Tree up to 30 m tall. **Bark** blackish, brown, or red-brown, fissured or flaky; inner bark soft, light brown or reddish, laminated; sap reddish. **Sapwood** yellowish or whitish. **Twigs** *stout*, *terete*, *not ridged*, *towards apex 4–7(–13) mm diameter*, initially tomentose with woolly hairs 1–1.5 mm long, late-glabrescent; bark dark brown, flaky; lenticels indistinct. Leaf buds 15(–20) mm long, pubescent with hairs 1–1.5 mm long. **Leaves** *distichous*, *membranous or chartaceous*, *surface not bullate*, *not scabrous*, *upper surface drying olivaceous or brown*, early glabrescent, *lower surface conspicuously tomentose with dendroid*, *more or less evenly spaced*, *about equal-sized hairs 0.5–1.5 mm long*, *without blackish dots*; elliptic-oblong to oblanceolate, *18–45 × 6.5–17 cm*, base almost rounded to attenuate, apex acute-acuminate; midrib slightly raised above, late-glabrescent; *lateral veins 18–25 pairs*, *sunken above*, glabrescent, distinct; *intercostal venation distinct above*; *petiole 1.2–1.7 cm long*, pubescent. **Inflorescences** woolly pubescent with hairs 1–1.5 mm long; bract 0.4–1 cm long, caducous; males 4-times branched, many-flowered, 6–16 × 3–12(–16) cm, peduncle 5–20 mm long; females 3–5 cm long. **Male flowers** glabrous or thinly pubescent; *pedicel* slender, 1–1.5 mm long, pubescent with hairs 0.3–0.5 mm long, subglabrescent, *at base not articulated*; *buds depressed subglobose*, *1.4–2 × 1.5–2 mm*; *perianth glabrous*, *3–4-lobed*, *at anthesis clefts to 1/3 to nearly halfway*; androecium depressed subglobose, 0.5–0.6 × 1–1.3 mm; *anthers 8–10*, sessile, column with apical cavity to 1/3(–1/2) deep; androphore 0.3(–0.5) mm long. **Fruits** 2–7 per infructescence, broadly ellipsoid, *2–2.2 × 1.5–1.8 cm*, *pubescent with hairs c. 0.5 mm long*; dry pericarp *c.* 3 mm thick; stalk *c.* 1 mm long; *perianth persistent*.

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In lowland mixed dipterocarp forest, edges of swamp forest, *kerangas* forest (with *Dryobalanops fusca* dominant), and lower montane forest, on brown soils, yellowish soils, and tuff-plateau, at 600–1500 m altitude. Flowering and fruiting throughout the year.

33. **Horsfieldia sterilis** W.J. de Wilde

(Latin, *sterilis* = sterile; the few reduced anthers)

Gard. Bull. Sing. 38 (1985) 224; Whitmore, Tantra & Sutisna *l.c.* 267. **Type:** *Aban SAN 30597*, Borneo, Sabah, Tawau district (holotype L; isotypes K, SAN, SING).

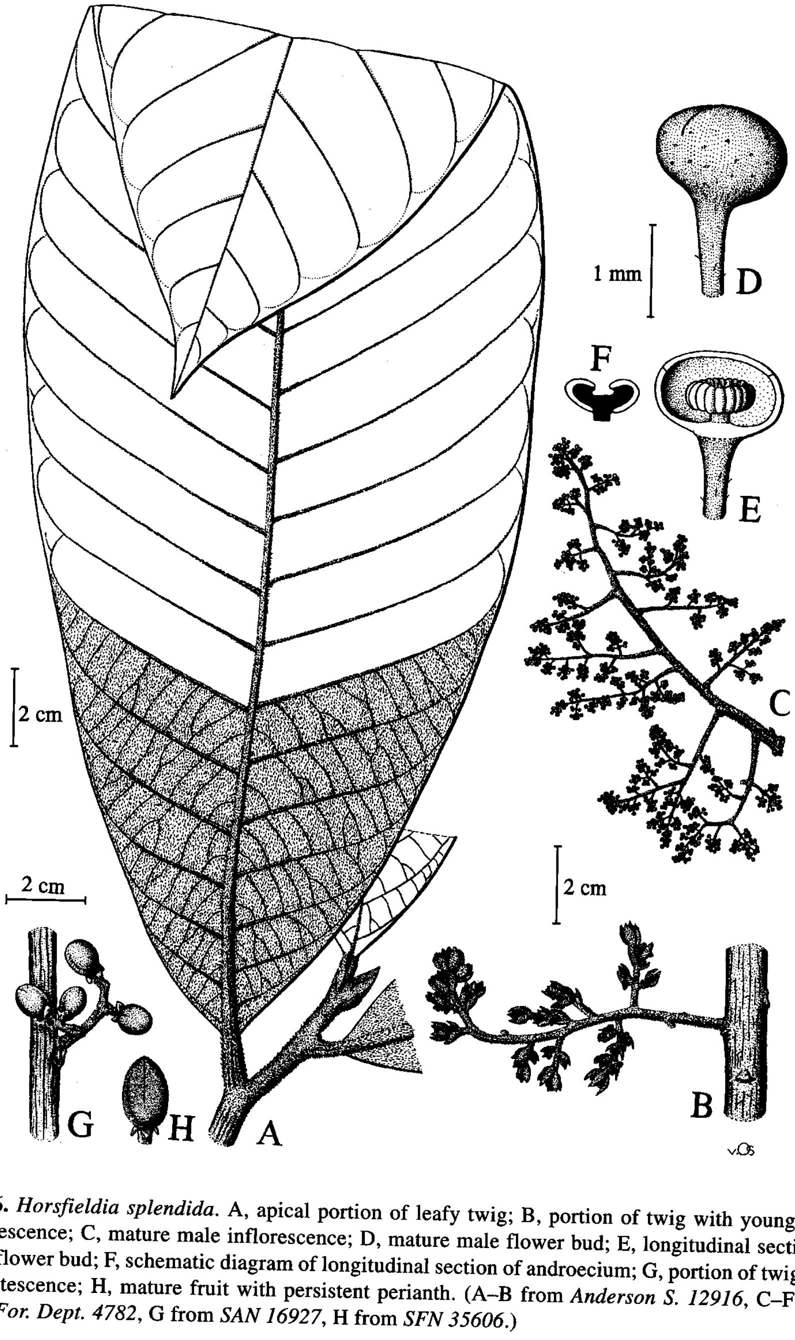

Fig. 6. *Horsfieldia splendida.* A, apical portion of leafy twig; B, portion of twig with young male inflorescence; C, mature male inflorescence; D, mature male flower bud; E, longitudinal section of male flower bud; F, schematic diagram of longitudinal section of androecium; G, portion of twig with infructescence; H, mature fruit with persistent perianth. (A–B from *Anderson S. 12916*, C–F from *BNB For. Dept. 4782*, G from *SAN 16927*, H from *SFN 35606*.)

Tree or shrub, up to 12 m tall. **Bark** grey-brown, non-fissured; inner bark with orange-red sap. **Sapwood** pale yellow. **Twigs** *terete*, towards apex 2.5–4(–8) mm diameter, *drying greyish brown*, *sometimes contrasting with the blackish colour of the drying petiole*, tomentose with hairs 0.1–0.2 mm long, glabrescent; bark not tending to crack or to flake; lenticels conspicuous or not. Leaf buds slender, 7–12 mm long, tomentose with hairs 0.1–0.2 mm long. **Leaves** *distichous*, *membranous*, *upper surface* glabrous, *drying blackish brown*, *lower surface glabrous*, *without dark dots*; elliptic to oblong-lanceolate, 13–37 × 4.5–9 cm, base attenuate, apex acute-acuminate; midrib flat above, glabrous; lateral veins 11–18 pairs, flattish or slightly raised above; petiole 0.7–2 cm long. **Inflorescences** tomentose with weak hairs 0.1–0.2 mm long, subglabrescent; bract 3–8 mm long, caducous; males lax, 10–20 × 5–8 cm, with few side branches, peduncle 3–13 cm long, with several bract scars, or branched from the base; *females* elongate, slightly branched, *almost spike-like*, *5–10 cm long*. **Male flowers:** *pedicel* 1–1.5 mm long, glabrous, *at base not articulated*; buds broadly obovoid-subglobose, 1.5–1.7 mm diameter, base subattenuate, slender; *perianth* glabrous, *2–lobed*, at anthesis clefts to *c.* 1/4; *androecium broadly obovoid*, *c.* 0.8 × 0.6–0.7 mm, *subcircular in transverse section*; *anthers 3 or 4* (or 6 or 8), sessile, *occupying only the apical part of the androecium*, with narrow thecae, column with apical cavity absent or very inconspicuous; androphore conspicuous, tapering, *c.* 0.4 mm long. **Fruits** 4–10 per spike-like infructescence, *ellipsoid*, 2.2–1.8 cm long, glabrous, drying blackish, not tuberculate; pericarp *c.* 2 mm thick; stalk 3–4 mm long; *perianth persistent.*

Distribution. Endemic to Borneo (SE Sabah and C Kalimantan).

Ecology. In mixed dipterocarp forest on hillsides and riverbanks, at 100–500 m altitude. Flowering from April–July.

34. **Horsfieldia subalpina** J. Sinclair

(Latin, *sub-* = somewhat, *alpinus* = growing in alpine zone of mountains; growing at rather high altitude)

Gard. Bull. Sing. 16 (1958) 410, *l.c.* (1975) 131; W.J. de Wilde *l.c.* (1986) 40; Turner *l.c.* 359. **Type:** *Wray 467*, Peninsular Malaysia, Perak, G. Batu Putih (holotype L; isotypes BM, CAL, K).

subsp. **kinabaluensis** W.J. de Wilde

(of Mt. Kinabalu, Sabah)

Gard. Bull. Sing. 39 (1986) 41; Whitmore, Tantra & Sutisna *l.c.* 267. **Type:** *Clemens 33136*, Borneo, Sabah (holotype L; isotypes A, BM, K, SING).

Tree up to 30 m tall. **Bark** slightly fissured, reddish brown; inner bark fibrous, whitish turning to brown, and then yellowish. **Sapwood** white to yellowish, medium-hard, heartwood not differentiated. **Twigs** *solid*, *not ridged*, *terete*, *drying dark grey-brown*, *not contrasting with the drying petiole*, *towards apex 2.5–5(–12) mm diameter*, *tomentose with hairs up to 0.1 mm long*, early glabrescent; bark not flaky; lenticels usually conspicuous. *Leaf buds* slender, 12–20 mm long, *pubescent with hairs up to 0.1 mm long*. **Leaves** *distichous*, *membranous to chartaceous*, *not bullate*, *not scabrous*, upper surface drying olivaceous-brown, *lower surface glabrous*, *without blackish dots or distinct hair scars*; elliptic-oblong to oblong, *15–27 × 5–10 cm*, base attenuate, apex sometimes somewhat blunt; midrib flat or slightly raised above; *lateral veins* 9–18(–20) pairs, *flattish above*; *petiole 0.5–1.5 cm long*, glabrous. **Inflorescences** on older twigs behind the leaves, *sparsely pubescent with hairs c. 0.1 mm long*; bracts 2–5 mm long, caducous; males 5–14 × 3–10 cm, peduncle (6–)10–30 mm long; females 2–7 cm long. **Flowers:** *perianth 3–4-lobed*, glabrous; *pedicel* glabrous, *at base not articulated*. **Male flowers:** *pedicel 1.5–2 mm long*; *buds broadly ellipsoid*, *1.7–2 × 1.5–1.8 mm*; *perianth at anthesis clefts to halfway*, *lobes at base 0.2–0.3 mm thick*; *androecium broadly ellipsoid*, *1.1–1.2 × 0.8–1 mm*; *anthers* 8 or 9, sessile, *more or less curved*, *almost entirely connate*, concealing apical cavity of the column up to 0.3–0.5 mm deep; androphore hidden by the anthers. **Female flowers:** pedicel *c.* 1.5 mm long; buds ellipsoid, 2–2.5 mm long; ovary glabrous. **Fruits** 2–6 per infructescence, broadly ellipsoid, *3–5 cm long*, top narrowly rounded, glabrous; dry pericarp 4–5 mm thick; stalk 3–7 mm long; perianth not persistent.

Distribution. Endemic to Borneo (Sabah: Mt. Kinabalu and vicinity; one doubtful collection, *Chai S. 35461*, from Sarawak).

Ecology. In lower to upper montane forests on clayish soils, at 1400–2000 m altitude. Flowering and fruiting throughout the year.

35. **Horsfieldia sucosa** (King) Warb.

(Latin, *succosus* = juicy; the sappy twigs)

Monogr. Myrist. (1897) 322; Gamble *l.c.* 217; Ridley *l.c.* 58; J. Sinclair *l.c.* (1958) 416 (*p.p.* incl. lectotype, excl. fig. 45 = *H. sparsa*), *l.c.* (1975) 139 *p.p.*; Whitmore *l.c.* 328; Anderson *l.c.* 265; W.J. de Wilde *l.c.* (1985) 188; Turner *l.c.* 359; Argent *et al.* (eds.) *l.c.* 452. **Basionym:** *Myristica sucosa* King, Ann. Bot. Gard. Calc. 3 (1891) 301. **Lectotype** (W.J. de Wilde, 1985)**:** *King's Collector 4647*, Peninsular Malaysia, Perak, Gopeng (holotype K; isotypes CAL, G, L). **Synonyms:** *H. bracteosa* Henderson, Gard. Bull. Str. Settl. 7, 2 (1933) 120, J. Sinclair *l.c.* 16 (1958) 419; *H. bracteosa* Henderson var. *bracteosa* J. Sinclair *l.c.* (1975) 18.

subsp. **bifissa** W.J. de Wilde

(Latin, *bifissus* = 2-cleft; the perianth)

l.c. (1985) 190; Whitmore, Tantra & Sutisna *l.c.* 267. **Type:** *Soegeng 58*, Borneo, Kalimantan, Kutai (holotype L; isotype BO).

Tree up to 20 m tall. **Bark** smooth, undulately fissured; inner bark *c.* 10 mm thick, laminated, reddish brown or yellow-brown. **Sapwood** whitish or pale brown, or reddish. **Twigs** terete, towards apex 2–10 mm diameter, *drying whitish or straw-coloured, contrasting with the blackish petiole*, tomentose with hairs 0.1–0.3 mm long, very early glabrescent; bark with a tendency to flake; lenticels conspicuous on the young parts. Leaf buds 10–15 mm long, pubescent with hairs 0.1–0.3 mm long. **Leaves** *in 2 or 3 rows*, *membranous* to thinly chartaceous, *upper surface* glabrous, *drying blackish brown*, often with a greenish tinge, *lower surface early glabrescent*, *without blackish dots*, but rather smaller blackish 'points' often present; elliptic-oblong to lanceolate, 14–28 × 4.5–8.5 cm, base attenuate or long-attenuate, apex acute-acuminate; midrib flat or only slightly raised above, glabrous; lateral veins 13–17 pairs, flat or slightly raised above; petiole 1–2 cm long. **Inflorescences** on older twigs behind the leaves, pubescent with hairs 0.1–0.2 mm long, late-glabrescent;

bract 1.5–4 mm long, late-caducous; males lax or condensed, 7–19 × 5–16 cm, peduncle 10–20 mm long; *females branched*, few-flowered, *1–2 cm long*. **Flowers:** *perianth mostly 2-lobed*, glabrous; *pedicel* usually glabrous, *at base articulated*. **Male flowers:** pedicel 1–2 mm long, slender; buds depressed globose, 1.2–1.4 × 1.5–1.7 mm; perianth at anthesis clefts to 1/3 to nearly 1/2; *androecium depressed globose*, 0.3–0.4 × 0.8–0.9 mm, broadly ellipsoid in transverse section; *anthers 7*, sessile; *column broad*, *more or less saucer-shaped*; androphore narrow, 0.1–0.3 mm long. **Female flowers:** buds broadly ellipsoid, 2.8–3.5 mm long; ovary glabrous. **Fruits** 1–4 per infructescence, *broadly ovoid-ellipsoid*, 2–3.5 × 2 cm, glabrous, drying blackish, sometimes more or less tuberculate; pericarp *c.* 4 mm thick; stalk 1–2 mm long; *perianth not persistent.*

Distribution. Endemic to Borneo (Sabah, Sarawak and Kalimantan).

Ecology. In lowland mixed dipterocarp forest on sandy loam soils, *Shorea laevifolia* forest on sandy ridge, and once recorded in forest over limestone, up to 800 m altitude. Flowering and fruiting throughout the year.

36. **Horsfieldia tenuifolia** (J. Sinclair) W.J. de Wilde Fig. 7.

(Latin, *tenuis* = thin, *folium* = leaf; thin-leaved)

Gard. Bull. Sing. 39 (1986) 11; Whitmore, Tantra & Sutisna *l.c.* 267; Coode *et al. l.c.* 223. **Basionym:** *H. polyspherula* (Hook. *f. emend.* King) J. Sinclair var. *tenuifolia* J. Sinclair *l.c.* (1975) 105. **Type:** *Bujang S. 13686*, Borneo, Sarawak (holotype SING; isotypes K, L, S, SAR).

Tree up to 15 m tall. **Bark** dark brown to greenish brown, narrowly fissured, not flaky; inner bark dark red; sap red. **Sapwood** whitish. **Twigs** *solid*, *not ridged*, *terete*, *drying not or little contrasting with the drying petiole*, *towards apex 1–3(–4) mm diameter*, *initially tomentose with hairs (0.1–)0.2 mm long*, *glabrescent*; *bark striate or finely cracked*; lenticels inconspicuous or absent. *Leaf buds* 5–8 mm long, *pubescent with hairs 0.1–0.2(–0.3) mm long*. **Leaves** *distichous*, *membranous to thinly chartaceous*, *not bullate*, *not scabrous*, *upper surface drying olivaceous to brown*, *not much contrasting with the lower surface*, *glabrous*, *lower surface glabrous*, *without blackish dots*; elliptic to oblong-lanceolate, *6.5–16.5 × 3–6.5 cm*, *base attenuate*, *apex acute-acuminate*; *midrib raised above*, glabrous or *sometimes late-glabrescent*, *at base narrow*; *lateral veins 5–11 pairs*, *distinctly raised above*; *petiole 0.8–1.6 cm long*, *0.1–0.2 cm diameter*. **Inflorescences** *sparsely tomentose with stellate hairs 0.1–0.2 mm long*, *glabrescent*; bract 2–3 mm, caducous; males 3–5 × 2–4 cm, *peduncle 2–10 mm long*; females slender, few-flowered, 2–3.5 cm long. **Flowers:** *perianth 3–4-lobed*, glabrous; *pedicel* with few hairs in the lower half, *at base indistinctly or not articulated*. **Male flowers:** *pedicel 1–2 mm long*; *buds subglobose*, *tapering into the pedicel*, *0.8–1.3 × 1–1.5 mm*; *perianth at anthesis clefts to 1/3 to nearly 1/2*; *androecium* almost obovoid, 0.5–0.7 × 0.5–0.8 mm, *in transverse section triquetrous*; *anthers* 4–6, *more or less erect*, *free for about halfway*, central column largely hollow; androphore tapering, 0.2–0.3 mm long. **Female flowers:** buds ellipsoid, *c.* 2 mm long; ovary glabrous. **Fruits** 1–3 per infructescence, *ellipsoid*, 1.7–2 × 1.4–1.5 cm, glabrous, drying dark brown, not tuberculate; pericarp 1–1.5 mm thick; stalk 3–5 mm long; *perianth not persistent*.

Distribution. Endemic to Borneo (Sabah, Sarawak and Brunei).

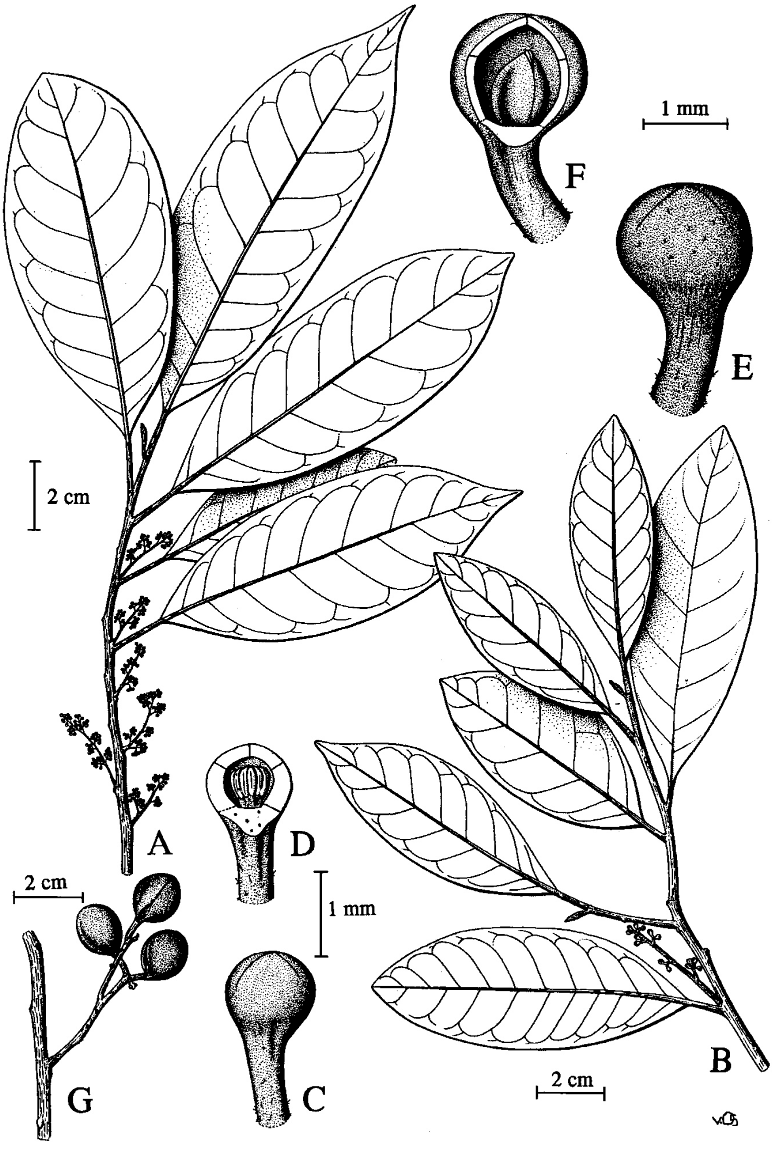

Fig. 7. *Horsfieldia tenuifolia*. A, flowering (male) leafy twig; B, flowering (female) leafy twig; C, mature male flower bud; D, opened male flower bud; E, mature female flower bud; F, opened female flower bud; G, portion of twig with infructescence bearing mature fruits. (A, C and D from *S. 24945*, B, E and F from *S. 34528*, G from *S. 24914*.)

Ecology. In lowland mixed dipterocarp forest on ridges and slopes, up to 300 m altitude, on yellow clay, yellow sandy clay, yellow loam, and brownish soils. Flowering and fruiting from May–September.

37. **Horsfieldia tristis** W.J. de Wilde

(Latin, *tristis* = dull-coloured; the drying leaves)

Gard. Bull. Sing. 38 (1985) 197; Whitmore, Tantra & Sutisna *l.c.* 267. **Type:** *Lai S. 37470*, Borneo, Sarawak (holotype L; isotypes K, KEP, MO, SAN, SAR, *n.v.*).

Tree up to 15 m tall. **Twigs** *terete*, *not ridged*, *towards apex 3–5(–7) mm diameter*, *pale brown to yellowish*, *contrasting with the drying petiole*, tomentose with hairs up to 0.1 mm long, early glabrescent; bark cracked or flaky; lenticels smallish. Leaf buds slender, 10–15 mm long, tomentose with hairs up to 0.1 mm long. **Leaves** *distichous*, *parchment-like*, membranous to *thinly chartaceous*, *upper surface not scabrous*, *drying dull olivaceous-brown and finely wrinkled*, *lower surface glabrous*, *not much contrasting in colour with the upper surface*, *without blackish dots*; *elliptic-oblong to lanceolate*, *14–32 × 4–8.5 cm*, base attenuate, apex acute-acuminate; midrib flat or slightly raised above, glabrous; lateral veins 11–17 pairs, flat or slightly raised or sunken above; *petiole 0.6–1.2 cm long*. **Inflorescences** sparsely tomentose with minute hairs *c.* 0.1 mm long; males 5–12 × 3.5–7 cm, peduncle 7–25 mm long; females (in fruit) 2–3 cm long, bracts caducous. **Male flowers:** *pedicel* slender, 1.5–5 mm long, glabrous, *at base not articulated*; *buds broadly ellipsoid*, *2.8–3.7 × 2–3 mm*; *perianth 3–4-lobed*, glabrous, *at anthesis clefts to 1/5–1/4* (to nearly 1/3); androecium obovoid-ellipsoid, in transverse section suborbicular or bluntly 3–4-angular, 2–2.7 × 1.5–2 mm; anthers 12–20, almost sessile; apical cavity of the column 0.5–0.8 mm deep; androphore 0.2–0.3 mm long, largely hidden by the anther bases. **Female flowers** not seen. **Fruits** 4–8 per infructescence, ellipsoid, *c. 1.5 × 1.2 cm*, apex subacute, glabrous, drying blackish, without lenticels or tubercles; pericarp *c.* 1.5 mm thick; stalk 1–2 mm long; *perianth not persistent*.

Distribution. Sumatra and Borneo (Sarawak and S Kalimantan).

Ecology. In forest on flat lands, up to 100 m altitude. Flowering in August and November, fruiting in September.

38. **Horsfieldia wallichii** (Hook. *f.* & Thomson) Warb.

(N. Wallich, 1786–1854, Danish botanist at Calcutta, India)

Monogr. Myrist. (1897) 305; J. Sinclair *l.c.* (1958) 405, *l.c.* (1975) 156; Anderson *l.c.* 265; W.J. de Wilde *l.c.* (1985) 204; Whitmore, Tantra & Sutisna *l.c.* 267; Turner *l.c.* 359; Coode *et al.* (eds.) *l.c.* 223. **Basionym:** *Myristica wallichii* Hook. *f.* & Thomson, Fl. Ind. (1855) 161. **Lectotype:** *Griffith s.n.*, Malacca (K).

Tree up to 30 m tall; bole straight; crown dense, monopodial. **Bark** shallowly or deeply longitudinally fissured, dark grey, not flaky; inner bark bright red, pink, reddish brown, or deep red. **Sapwood** whitish, pale or dirty yellowish, light brown, brown or red-brown. **Twigs** *terete or drying somewhat flattened*, *not ridged*, *usually conspicuously hollow*, *towards apex 3–6(–9) mm diameter*, *tomentose with hairs 0.3–0.6 mm long*, late-glabrescent; without or with inconspicuous lenticels; older twigs sometimes flaky. *Leaf buds* 20–30 mm long, *pubescent with hairs 0.3–0.6 mm long*. **Leaves** *distichous*, *membranous to coriaceous*, *surface not scabrous*, *not bullate*, *upper surface drying olivaceous or brown*, glabrous (with minute tomentum remaining on the midrib or not), *lower surface early glabrescent or tomentose with locally persistent hairs (0.3–)0.5–0.8 mm long*, *always with scattered brown-black dots and streaks of irregular size*; ovate-oblong to oblong-lanceolate, *(14–)19–40 × (4–)4.5–12 cm*, base rounded or short-attenuate, apex subobtuse to acute-acuminate; midrib slightly raised above, late-glabrescent; lateral veins (12–)15–28 pairs, flat or sunken above; *petiole 1.5–3.5 cm long*. **Inflorescences** usually on older twigs behind the leaves, *tomentose with hairs 0.5–1 mm long*; bract 3–10 mm long, caducous; males 4–5-times branched, 10–33 × 6–22 cm, peduncle 30–70 mm long; females rather stout, 3–7 cm long. **Flowers** glabrous or glabrescent; *perianth 3–4-lobed*; *pedicel at base not articulated*. **Male flowers:** *pedicel 0.3–0.6(–1) mm long*; *buds broadly obovoid*, *2–2.5(–3) × 2.4–2.5(–3) mm*, *base more or less attenuate*, glabrous; *perianth at anthesis clefts to 1/3–2/3*; androecium subglobose, subsessile, apex more or less depressed with a triradiate crack, faintly angular, 1.3–2 × 1.5–2 mm; anthers (12?–)15–23, sessile, closely appressed; apical cavity of column up to *c*. halfway deep. **Female flowers:** buds ovoid-ellipsoid, 2.5–4 mm; ovary glabrous. **Fruits** 2–9 per infructescence, ovoid-ellipsoid, *4–6(–7) × 3–4.5 cm*, glabrous; dry pericarp 10–15 mm thick; stalk stout, 4–6 mm long; *perianth generally persistent*. **Seeds** ellipsoid, with orange aril.

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In lowland and ridge-top forests, on 'red' soils, granitic sandy soils, loam soils with coral limestone, up to 500 m altitude. Flowering and fruiting throughout the year.

39. **Horsfieldia xanthina** Airy Shaw

(Greek, *xanthos* = yellow; the yellow flowers)

Kew Bull. 1939, no. 10 (1940) 541; Masamune *l.c.* 302; Anderson *l.c.* 266; W.J. de Wilde *l.c.* (1986) 45, *l.c.* (1996) 381. **Type:** *Richards 1927*, Borneo, Sarawak, Marudi district, Mt. Dulit (holotype K; isotypes A, SING).

Tree up to 30 m tall. **Twigs** *solid*, *not ridged*, *subterete*, *towards apex 2.5–6(–16) mm diameter*, *drying dark brown*, *not contrasting with the drying petiole*, *tomentose with hairs c. 0.1 mm long*, glabrescent; bark with a tendency to flake or not; lenticels conspicuous or not. *Leaf buds* 8–13 mm long, *pubescent with hairs 0.1(–0.2) mm long*. **Leaves** *distichous*, *coriaceous*, *not bullate*, *not scabrous*, upper surface drying olivaceous to brown, usually with distinct hair scars, *lower surface* drying usually with a reddish brown tinge, *usually with distinct hair scars*, *without blackish dots*, *early glabrescent*; elliptic to oblong-lanceolate, *8–35 × 3.5–13 cm*, base attenuate to short-rounded, apex subacute to acute-acuminate; midrib slightly raised above; *lateral veins* 8–20 pairs, *flat or slightly raised above*; *petiole 0.7–1.2 cm long*. **Inflorescences** on older twigs behind the leaves, *pubescent with hairs c. 0.1 mm long*; bract caducous; males robust, (2–)4–20 cm long, few-flowered, peduncle 5–8 mm or 15–20 mm (subsp. *macrophylla*) long, flowers in loose clusters of 3–5(–8), reflexed or not; females 1–1.5 or 5–7 (subsp. *macrophylla*) cm long, few-flowered. **Flowers** glabrous; *perianth 3–4-lobed*; *pedicel* glabrescent, towards the base pubescent with hairs *c.* 0.1 mm long, *at base not articulated*. **Male flowers:** pedicel rather thick, tapering or not, straight or more or less curved (flowers reflexed), 1–2.5 mm long; *buds more or less obovoid or ellipsoid*, *2.5–2.8 mm long*, base somewhat tapering into the pedicel; *perianth at anthesis clefts to 1/2(–2/3)*, not collapsing on drying, *lobes coriaceous 0.4–0.8(–1) mm thick*; *androecium more or less laterally flattened*, almost broadly obovoid in outline, 1–1.3 mm long; *anthers* (3–)4–8, *more or less curved*, *almost entirely connate*, *c.* 1 mm long, sessile, free apices 0.1–0.3 mm long; column broad, solid, at apex with shallow cavity; *androphore broad*, *more or less tapering*, *(0.1–)0.2–0.3 mm long*. **Female inflorescences** and **flowers** known only in subsp. *macrophylla*; ovary glabrous. **Fruits** 2–6 per infructescence, more or less ellipsoid, *c. 5 cm long*, glabrous; stalk stout, *c.* 3 mm long; perianth not persistent.

Distribution. Endemic to Borneo (Sabah and Sarawak).

Ecology. In hill mixed dipterocarp to lower montane forests.

Key to subspecies

Twig moderately slender, towards apex 2.5–4.5(–8) mm diameter. Leaves 8–18 × 3.5–7 cm. Male inflorescences 2–5 cm long; flowers often more or less reflexed; anthers 6....

subsp. **xanthina**

W.J. de Wilde *l.c.* (1986) 46; Whitmore, Tantra & Sutisna *l.c.* 268.

Tree up to 17 m tall. Male flower buds subglobose or broadly ellipsoid, *c.* 2.5 × 2.2–2.5 mm; at anthesis perianth clefts to 1/2–2/3; pedicel 2–2.5 mm long; androecium slightly laterally compressed. Young fruits ellipsoid-obovoid.

Endemic to Sarawak. In *kerangas*, lower montane and limestone forests, at 800–1150 m altitude.

Twig stout, towards apex 3.5–6(–16) mm diameter. Leaves 22–35 × 7–13 cm. Male inflorescences 10–20 cm long; flowers erect; anthers 7–8...

subsp. **macrophylla** W.J. de Wilde

(Greek, *makro* = large, *phullon* = leaf; large-leaved)

l.c. (1986) 47, *l.c.* (1996) 381; Whitmore, Tantra & Sutisna *l.c.* 268. Type: *Clemens 50050*, Borneo, Sabah, Mt. Kinabalu (holotype K; isotypes BM, L).

Tree up to 30 m tall. Bark of twig not flaky. Bark brown and grey, fissures boat-shaped; sap light red, watery. Male flowers: pedicel 1–1.5 mm long; buds broadly ellipsoid, 2.6–2.8 × 2.5–2.7 mm; perianth 3-lobed, at anthesis clefts to nearly halfway; androecium *c.* 1.3–0.8 mm long, subtriquetrous in transverse section. Female inflorerscences (0.5–)1–8 cm long, once (or twice) branched. Female flowers: pedicel 1.5–2 mm long, glabrous or with minute hairs towards the base; buds ovoid-ellipsoid, 4–4.5 × 3–3.5 mm; perianth 3-lobed, at anthesis clefts to nearly halfway; ovary *c.* 2.2 × 2 mm, glabrous. Fruits glabrous, *c.* 5 × 3–3.5 cm; pericarp 5(–10) mm thick, woody towards inside.

Endemic to Borneo (Sarawak and Mt. Kinabalu in Sabah). In lower montane forest, ridge forest, on igneous derived (andesitic) soils, at 1100–1300 m altitude. Flowering in July and November; fruiting in November.

4. **KNEMA** Lour.

(Greek, *knema* = the spoke of a wheel; the stamens in the androecium)

penarahan (preferred name), *darah-darah* (Malay), *kumpang* (Iban)

Fl. Coch. (1790) 604; Warburg, Monogr. Myrist. (1897) 132, 543; Gamble, J. As. Soc. Beng. 75, 2 (1912) 236; Ridley, FMP 3 (1924) 66; J. Sinclair, Gard. Bull. Sing. 16 (1958) 254, *ibid*. 18 (1961) 102; Backer & Bakhuizen *f.*, FJ 1 (1964) 139; Whitmore, TFM 1 (1972) 330; W.J. de Wilde, Blumea 25 (1979) 321, *ibid*. 27 (1981) 223, *ibid*. 32 (1987) 115, *ibid*. 41 (1996) 382, *ibid*. 43 (1998) 241; Anderson, CLTS (1980) 266; Corner, WSTM 3rd. edition 2 (1988) 564; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 268; Coode *et al.* (eds.), CLBD (1996) 224; Argent *et al.* (eds.), MNDT-CK 2 (1997) 452; PROSEA 5, 3 (1998) 317.

Dioecious trees; stilt roots sometimes present. **Twigs** towards apex variously pubescent, glabrescent, smooth or striate, lower down sometimes tending to crack or flake. **Leaves** up to 65 cm long, membranous to coriaceous, *not brittle when dry*; when young covered with various tomentum, upper surface early glabrescent, *lower surface glaucous or greyish*, glabrescent or with various persistent tomentum, dark dots present or absent; lateral veins interarching at the leaf margin, usually distinct above, always distinct beneath; intercostal venation reticulate, distinct and prominent above; petiole, in some species with cordate leaf base, somewhat pulvinate in the apical portion. **Inflorescences** axillary to leaves or fallen leaves, *consisting of sessile or short-peduncled*, *simple or 2(–3)-fid scar-covered brachyblasts*; *bracts caducous*; *flowers in terminal subumbellate clusters*, mostly numerous in males, few in females. **Male flowers** pedicelled; *bracteole minute*, *persistent or caducous*, *located at the base or at about the middle part of the pedicel*; buds ellipsoid, obovoid, depressed globose or mitriform, at base attenuate, broadly rounded, or more or less saccate, in section circular or trigonous; perianth 3(–5)-lobed, at anthesis clefts to *c.* halfway to nearly to the base, lobes spreading; *androecium comprising a cylindrical or tapering staminal column* (androphore) of various lengths, and *apical*, circular, peltate, flat to convex or mamillate *staminal disc* (synandrium) *to which the anthers are radially attached by their bases*; anthers 3–25, sessile, or shortly stiped, horizontal or suberect, spaced or touching each other. **Female flowers** subsessile or pedicelled, in bud obovoid, or ellipsoid-oblong; perianth 3(–4)-lobed, at anthesis clefts to *c.* halfway; ovary ovoid to globose, variously pubescent; style short or absent, *stigma 2–many-lobed*, each lobe 2–several-lobulate. **Fruits** sessile or stalked; pericarp thick, hard and fleshy or more or less woody, with various tomentum, sometimes early glabrescent. **Seeds** *not pointed at one end*; *testa not variegated*; *aril shallowly laciniate or convoluted at the apex only* (to *c.* 1/3), rarely completely closed; endosperm with a fixed oil and starch.

Distribution. A genus comprising about 93 species distributed in continental SE Asia and Malesia, from the Deccan Peninsula (India) to S China (Yunnan), eastwards to the Philippines, Maluku and W New Guinea. Most species are found in Borneo, of which 44 species are recorded for Sabah and Sarawak.

Ecology. Mostly under- and middle-storey trees of primary and degraded, usually ever wet forests, up to 1800(–2000) m altitude. In continental SE Asia also occur in seasonal forest.

Key to *Knema* species

1. Lower leaf surface densely tomentose with persistent, appressed, tightly interwoven hairs, silky to the touch..........2

   Lower leaf surface either glabrous (glabrescent), or with various tomentum, silky or not silky to the touch..........4

2. Bark of twig longitudinally cracked and flaky..........**4. K. elmeri**

   Bark of twig not cracked or flaky..........3

3. Tomentum of flowers consists of hairs *c*. 0.1 mm long. Fruits subglobose to broadly ovoid, 3.5–5 cm long. Staminal disc conspicuously convex. Reticulation of intercostal venation on the upper leaf surface coarse..........**37. K. sericea**

   Tomentum of flowers very inconspicuous, composed of stellate scale-like hairs *c*. 0.1 mm long or less. Fruits obovoid-oblong to oblong, 5–8 cm long. Staminal disc flat. Reticulation of intercostal venation on the upper leaf surface finer..........**1. K. ashtonii** (var. **cinnamomea**)

4. Bark of twig longitudinally cracked, when older flaky..........5

   Bark of twig not cracked or flaky..........13

5. Flowers wholly or largely glabrescent..........6

   Flowers with persistent tomentum..........8

6. Fruits tomentose with persistent hairs *c*. 1 mm long..........**32. K. psilantha**

   Fruits glabrescent..........7

7. Flower buds more or less mitriform (sharply angled), 7–15 mm long. Twig towards apex 4–10 mm diameter, brown..........**6. K. galeata** (in part)

   Flower buds not sharply angled, 3.5–5 mm long. Twig towards apex 1.5–3 mm diameter, often yellowish..........**23. K. membranifolia** (in part)

8. Tomentum of twigs and flowers comprising hairs (2–)3–4 mm long..........**20. K. longepilosa**

   Tomentum of twigs and flowers comprising hairs 0.1–2(–2.5) mm long..........9

9. Twig rather slender, towards apex (1–)2–4(–8) mm diameter. Female flower with pedicel up to 2 mm long..........10

   Twig stout, towards apex 4–12 mm diameter. Female flower with pedicel 2–20 mm long..........11

10. Male flower bud depressed ovoid to depressed globose, 3–4.5 mm diameter; pedicel (1.5–)2–3(–6) mm long; bracteole apical; staminal disc flat or faintly convex..........**16. K. latericia**

    Male flower bud depressed globose, 4–6 mm diameter; pedicel (4–)5–10 mm long; bracteole median; staminal disc mammillate..........**13. K. korthalsii** (subsp. **rimosa**)

11. Male flower bud 6–10 mm long. Fruits 3.5–7 cm long; stalk 10–30 mm long..........**27. K. pallens**

Male flower bud less than 6 mm long. Fruits 2–4.5 cm long; stalk 0–3(–5) mm long……………………………………………………………………………12

12. Leaves chartaceous or thinly coriaceous, upper surface drying brown; leaf base obtuse or subcordate (or rarely narrowed)………………………………**21. K. lunduensis**
Leaves usually coriaceous, upper surface drying olivaceous-brown; leaf base attenuate to rounded……………………………………………………………**30. K. percoriacea**

13. Lower leaf surface with minute reddish brown to blackish dots…………………………14
Lower leaf surface without such dots……………………………………………………18

14. Twig slender, towards apex 1–1.5 mm diameter. Leaves glabrescent beneath. Fruits obovoid-oblong, 1.7–1.8 cm long………………………………………**25. K. muscosa**
Twig stout, towards apex 1.5–6 mm diameter. Lower leaf surface with persistent or subpersistent tomentum. Fruits of various shapes, 1.5–4 cm long…………………15

15. Tomentum of lower leaf surface consisting of scattered, minute, stellate hairs *c*. 0.1 mm long, sometimes with a few larger ones scattered in-between………**15. K. kunstleri**
of lower leaf surface consisting of stellate and stellate-dendroid hairs *c*. 0.2–1.2 mm long……………………………………………………………………………16

16. Leaves 4–15 cm long, upper surface drying dark brown. Perianth inside hairy………
………………………………………………………………………**33. K. pubiflora**
Leaves 10–36 cm long, upper surface drying olivaceous-brown. Perianth inside glabrous……………………………………………………………………………17

17. Pedicel of male flower 7–15 mm long, and that of female flower 5–8(–10) mm long. Perianth 3–4-lobed, at base inside without a disc. Fruits usually ellipsoid or obovoid, (1.5–)2–4 cm long; stalk 5–10 mm long………………………………**2. K. conferta**
Pedicel of male flower 20–30 mm long, that of female flower 10–12 mm long. Perianth 4–5-lobed, at the base inside with a disc. Fruits subglobose, usually somewhat broader than long, 2–3 × 2.5–2.8 cm; stalk 18–30 mm long………………**29. K. pedicellata**

18. Fruits glabrescent. Flower buds pubescent or glabrescent. Bark of twigs usually yellowish or purplish……………………………………………………………19
Fruits pubescent or glabrescent. Flower buds with persistent tomentum. Bark of twigs yellow-brown, grey-brown or blackish………………………………………………23

19. Twig towards apex 4–10 mm diameter. Male flower buds 6–10 mm long, more or less mitriform …………………………………………………**6. K. galeata** (in part)
Twig towards apex 1–4.5 mm diameter. Male flower buds 2.5–7 mm long, depressed globose, subglobose or ovoid…………………………………………………………20

20. Twig towards apex at first tomentose with hairs *c*. 1 mm long, glabrescent…………
……………………………………………………………**23. K. membranifolia** (in part)
Twig towards apex at first tomentose with hairs 0.1–0.5 mm long……………………21

21. Leaves 17–30 cm long. Pedicel stout. Fruits 5–6 cm long; pericarp *c*. 10 mm thick…………………………………………………………………**43. K. viridis**

Leaves up to 20(–25) cm long. Pedicel slender. Fruits 2–5 cm long; pericarp 1–2.5 mm thick……………………………………………………………………22

22. Tomentum of twig towards apex consisting of hairs 0.2–0.5 mm long. Fruit stalk (2–)5–8 mm long……………………………………………**19. K. linguiformis**
Tomentum of twig towards apex consisting of hairs *c*. 0.1 mm long or less. Fruit stalk 8–16 mm long……………………………………………………**3. K. curtisii**

23. Tomentum of twig towards apex comprising hairs more than 0.2 mm long……………24
Tomentum of twig towards apex comprising hairs 0.1–0.2 mm long…………………32

24. Lower leaf surface with persistent tomentum or late-glabrescent………………25
Lower leaf surface early glabrescent (sometimes with some tomentum persisting on midrib and veins in *K. glomerata*)……………………………………………27

25. Tomentum of lower leaf surface consisting of more or less uniformly stalked dendroid hairs. Fruits tomentose with hairs 1–3 mm long; stalk 0–1(–5) mm long……………………………………………………………………**18. K. laurina**
Tomentum of lower leaf surface consisting of sessile-stellate and stellate-dendroid hairs of various sizes. Fruits tomentose with hairs 0.2–1.5 mm long; stalk 2–10 mm long……………………………………………………………………26

26. Female flower buds 6–7.5 mm long. Fruits 2–3.8 cm long, tomentose with hairs 1–1.5 mm long; stalk 3–10 mm long. Male flower buds 2.5–5 mm diameter……………………………………………………………………**26. K. oblongata**
Female flower buds 2–2.5 mm long. Fruits 1.4–2 cm long, tomentose with hairs 0.2–0.5 mm long; stalk 2–3 mm long. Male flower buds 1.5–2.5 mm diameter……………………………………………………………**41. K. tridactyla** (in part)

27. Leaves above drying brown or blackish. Fruits tomentose with hairs *c*. 3 mm long……………………………………………………………………**36. K. rufa**
Leaves above drying olivaceous-brown. Tomentum of fruits consists of hairs 0.1–0.5(–1) mm long……………………………………………………………28

28. Leaves generally coriaceous; midrib and lateral veins prominently raised above; reticulation of intercostal venation raised and distinct above…………………29
Leaves generally chartaceous; midrib and lateral veins flat or slightly raised above; reticulation of intercostal venation slightly raised and less distinct above…………30

29. Bracteole attached on the pedicel at about halfway. Staminal disc long-mammillate……………………………………………………**11. K. intermedia**
Bracteole subapically attached on the pedicel. Staminal disc convex or low-mammillate……………………………………………………**42. K. uliginosa**

30. Twig rather stout, towards apex 3–5 mm diameter. Fruits 1.5–4 cm long, tomentose with hairs 0.5–1 mm long; stalk 2–6 mm long………**13. K. korthalsii** (subsp. **korthalsii**)
Twig slender, towards apex 1.5–2.5(–3) mm diameter. Fruits 1.5–2.5(–3) cm long, tomentose with hairs 0.1–0.2(–0.5) mm long; stalk 4–6(–10) mm long……………31

31. Fruit stalk 4–6(–10) mm long; fruits pubescent with scurfy hairs 0.1–0.2 mm long. Leaves drying greenish brown above; reticulation of intercostal venation indistinct.… ……………..……………………………………………….....………...**9. K. glomerata**
Fruit stalk slender, 7–10 mm long; fruits with hairs up to 0.5 mm long. Upper surface of leaves drying conspicuously green-olivaceous; reticulation of intercostal venation distinct…………………………………………...…………………**5. K. emmae**

32. Fruits largely glabrescent, somewhat flat, often ridged, at base somewhat saccate. Leaves elliptic-oblong or obovate-oblong, upper surface drying dark brownish to blackish, lower surface often tinged reddish brown or purplish. Anthers 3 or 4...…………………....……..**17. K. latifolia**
Fruits either with persistent tomentum, or glabrescent and then not saccate at the base. Leaves of various shapes; upper surface drying olivaceous or brown, lower surface greyish. Anthers 5–25 ……………………...............……………………33

33. Female flower buds 2–2.5 mm long. Fruits 1.4–2 cm long; stalk 2–3 mm long. Anthers 5 or 6 ....…………………………….........………**41. K. tridactyla** (in part)
Female flower buds 3.5–7 mm long. Fruits of various size; stalk usually more than 3 mm long. Anthers 6 or more.......…………….........…........…………………...34

34. Twig stout, towards apex 4–6 mm diameter. Fruits 6–8 cm long, with blunt or rounded apex. Reticulation of intercostal venation on the upper leaf surface very fine, areoles *c.* 0.5 mm diameter or less.......……….…………........…...**1. K. ashtonii** (var. **ashtonii**)
Twig various, towards apex 1–6(–8) mm diameter. Fruits smaller, if over 6 cm long, then apex acute, not rounded. Reticulation of intercostal venation on the upper leaf surface various....……………………………...........………………………35

35. Perianth of male flower 1–2 mm thick at the sutures.......…......…………………………36
Perianth of male flower up to 1 mm thick at the sutures.......…......………………………37

36. Twig towards apex usually blackish brown and more or less angled by ridges from the bases of the petioles. Leaves thinly coriaceous; lateral veins 22–30 pairs..**44. K. woodii**
Twig towards apex pale brown or greyish brown, not angled. Leaves coriaceous or rigidly coriaceous; lateral veins 25–50 pairs.......…………......………..**28. K. pectinata**

37. Leaf base broadly rounded to cordate. Twig rather stout, towards apex 2–8 mm diameter. Leaves up to 50 cm long.......……………………...............……………………38
Leaf base attenuate, cuneate to rounded. Twig usually more slender, towards apex 1–3.5 mm diameter. Leaves up to 30 cm long.......………..........……...………39

38. Twig towards apex 3–6(–8) mm diameter. Leaves (20–)30–50 × (6–)10–17 cm; lateral veins flat or slightly raised above. Fruits subglobose to ellipsoid-oblong, (3–)4–6 cm long, apex rounded. Male flower buds pear-shaped...……......……..**34. K. pulchra**
Twig towards apex 2–4 mm diameter. Leaves 12–30 × 5.5–12 cm; lateral veins sunken to flattish above. Fruits oblong, oblong-lanceolate to almost fusiform, (5–)7–8 cm long, apex long-acute. Male flower buds depressed globose.…...…**14. K. kostermansiana**

39. Leaves coriaceous to rigidly coriaceous; intercostal venation on the upper leaf surface forming a raised and very distinct network.......……....……………**12. K. kinabaluensis**

membranous, chartaceous to thinly coriaceous; intercostal venation on the upper leaf surface distinct or not........……………………………....................…………………40

40. Twig towards apex usually somewhat flat, drying yellow-brown. Intercostal venation on the upper leaf surface forming a distinct very fine network, the areoles less than 0.5 mm diameter........………………………….……………………….………..**22. K. luteola**
Twig towards apex terete or somewhat angular, drying brown to blackish. Intercostal venation on the upper leaf surface generally coarser, distinct or not distinct........…........…41

41. Fruits glabrescent. Bracteole usually persistent. Lower leaf surface subglabrous, early glabrescent……………………....…………………………….……………**7. K. glauca**
Fruits with persistent tomentum. Bracteole persistent or caducous. Tomentum of lower leaf surface persistent or glabrescent.......……............……………………..…………42

42. Male flower buds pear-shaped, much tapered in the lower half……....**31. K. piriformis**
Male flower buds obovoid or globose or subglobose........………….....……………...43

43. Lower leaf surface early glabrescent. Style distinct, 0.5–1 mm long. Male flower buds obovoid…………………....…………………………………………**39. K. stylosa**
Lower leaf surface with persistent tomentum or late-glabrescent. Style up to 0.5 mm long. Male flower buds obovoid or globose or subglobose.......…............…...….....44

44. Tomentum of lower leaf surface consisting of dense, touching or interwoven hairs........…45
Tomentum of lower leaf surface comprising scattered hairs, not touching each other........46

45. Hairs of plant parts brown. Lateral veins usually raised above. Fruits 1.8–2.2 cm long…………………………....………………………………….**8. K. glaucescens**
Hairs of plant parts yellowish or greyish white. Lateral veins flat or partially raised above. Fruits *c.* (3–)4 cm long.........…………...............……………**35. K. riangensis**

46. Twig slender, towards apex *c.* 1 mm diameter. Leaves up to 18 cm long, lower surface with very inconspicuous tomentum of scattered scale-like stellate hairs of less than 0.1 mm long. Fruit 1–1.5 cm long, stalk 10–20 mm long……….....………………… ……………………………......……………**38. K. stenophylla** (subsp. **longipedicellata**)
Twig towards apex generally stouter, 1–3.5 mm diameter. Leaves up to 25 cm long, lower surface tomentose with hairs 0.1–0.3 mm long. Fruit 1.5–3.5 cm long, stalk up to 10(–15) mm long.......……………....…………………....…………………………47

47. Twig slender, towards apex 1–1.5(–2) mm diameter. Reticulation of intercostal venation on the upper leaf surface rather faint. Anthers 6–8. Fruit 1.5–2 cm long……………………………………….....……………………..**24. K. mogeana**
Twig towards apex generally stouter, 1.5–3 mm diameter. Reticulation of intercostal venation on the upper leaf surface distinct. Anthers (7–)9–13(–15). Fruit 2 cm long or more.....…………………………………......……………………………...48

48. Twig towards apex 1.5–2(–2.5) mm diameter. Leaves 9–20 cm long. Staminal column (almost) glabrous. Fruit 2–2.7 cm long.......…………………………**40. K. subhirtella**
Twig towards apex 2–3.5 mm diameter. Leaves (7–)10–23 cm long. Staminal column pubescent towards the base. Fruit 2.5–3.5 cm long………......……………**10. K. hirtella**

1. **Knema ashtonii** J. Sinclair

(P.S. Ashton, 1934–, sometime forest botanist at the Forestry Departments of Brunei Darussalam and Sarawak; Professor of Dendrology, Harvard University, U.S.A.)

Gard. Bull. Sing. 18 (1961) 162 (excl. male flowers); W.J. de Wilde, Blumea 25 (1979) 384, *ibid*. 41 (1996) 382; Anderson *l.c.* 266; Whitmore, Tantra & Sutisna *l.c.* 268; Argent *et al.* (eds.) *l.c.* 454. **Type:** *Smythies, Wood & Ashton SAN 17386*, Brunei, Temburong district (holotype K; isotypes A, BO, BRI, BRUN, KEP, L, SAN, SING).

Tree up to 25 m tall. **Twigs** *stout*, *towards apex ridged, 4–6 mm diameter*, *tomentose with hairs c. 0.1 mm long*, glabrescent; *bark drying brown or blackish, not cracked or flaked*. **Leaves** thinly coriaceous, *upper surface drying olivaceous*, *lower surface* not papillose, *without brownish or blackish dots*, *glabrous or sparsely or densely greyish or cinnamon tomentose with silky hairs 0.1–0.2 mm long*; *obovate-oblong to oblong-lanceolate*, 25–55 × 7–15 cm, base subcordate to attenuate; midrib raised above; lateral veins 20–40 pairs, flat or depressed above; *intercostal venation more or less trabeculate*, *very fine on the upper surface*; petiole 1–3 cm long. **Inflorescences** up to 1 × 0.5 cm; males 4–10-flowered; *flowers pubescent with minute stellate scale-like hairs less than 0.1 mm long*. **Male flowers:** buds obovoid, 5.5–8 mm long; perianth at anthesis clefts to *c*. 4/5; *staminal disc flat*; *anthers 6 or more*; bracteole inserted on the apical part of the pedicel, caducous. **Female flowers:** *buds 5–6 × 4 mm*; pedicel 5–6 mm long. **Fruits** 1–3 per infructescence, *obovoid-oblong*, *oblong* to long-ellipsoid, *5–8 × 3–4 cm*, *with blunt or rounded apex*, *tomentose with persistent hairs c. 0.2 mm long*; dry pericarp *c*. 4 mm thick; *stalk 10–30 mm long*, the bracteole scars situated about halfway to near the apex; collar-like perianth scar present at the base of the fruit.

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei and Kalimantan).

Ecology. In primary mixed dipterocarp forest, often by streams, up to 600 m altitude. Flowering in March to April; fruiting throughout the year.

Key to varieties

Lower leaf surface (nearly)glabrous or with scattered grey scaly hairs not silky to the touch. Fruit stalk 10–15(–20) mm long; bracteole scars attached to the pedicel usually above the middle. Pedicel of male flower *c*. 9 mm long..

var. **ashtonii**

W.J. de Wilde *l.c.* (1979) 386, *l.c.* (1996) 382; Coode *et al.* (eds.) *l.c.* 224.

Bark smooth, ochre. Stilt roots occasionally present. Male flower buds *c*. 5.5 × 4.5–5 mm; pedicel *c*. 9 mm long; staminal column *c*. 2 mm long, staminal disc faintly convex, including anthers *c*. 3 mm diameter. Fruits (5–)6–7.5(–8) cm.

Sabah, Sarawak and Brunei.

Lower leaf surface densely brownish grey to cinnamon-brown pubescent, silky to the touch. Fruit stalk 20–30 mm long; bracteole scar attached to the pedicel usually at about the middle. Pedicel of male flower 20–25 mm long..

var. **cinnamomea** W.J. de Wilde

(Latin, *cinnamomeus* = cinnamon-coloured; the indumentum of lower leaf surface)

l.c. (1979) 386. Type: *Suib S. 23449*, Borneo, Sarawak (holotype L; isotypes K, SAR, SING).

Bark smooth, reddish to greyish brown, without furrows or flakes. Male flower buds

7–8 × 6 mm; pedicel 20–25 mm long; staminal column tapering, 1.5–2 mm long, staminal disc subtriangular, flat, including anthers *c.* 3.5 mm diameter. Fruits 5–8 cm long.

Sarawak and Kalimantan. Often found by streams on sandy, basalt-derived, and clay-rich soils, at altitudes up to 600 m.

2. **Knema conferta** (King) Warb.

(Latin, *confertus* = pressed together; male flowers densely crowded)

Monogr. Myrist. (1897) 578; Gamble *l.c.* 243; Merrill *l.c.* (1921) 270, *l.c.* (1929) 74; Ridley *l.c.* 70; Masamune *l.c.* 302; J. Sinclair *l.c.* (1958) 286, *l.c.* (1961) 194; W.J. de Wilde *l.c.* (1979) 472; Anderson *l.c.* 266; Whitmore, Tantra & Sutisna *l.c.* 268; Turner, Gard. Bull. Sing. 47 (1995) 360; Argent *et al.* (eds.) *l.c.* 455. **Basionym:** *Myristica conferta* King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 315. **Lectotype** (W.J. de Wilde, 1979): *King's Collector 6211*, Peninsular Malaysia, Perak, Larut (hololectotype CAL; isolectotypes FI, G, K, L).

Tree up to 25 m tall; bole straight, occasionally with buttresses up to 3 m high, extending over the ground *c.* 30 cm wide, *c.* 10 cm thick. **Bark** smooth or somewhat rough, peeling off in narrow strips or in isodiametric scales 1–1.5 mm thick; inner bark 5–8 mm thick, light red or red-brown. **Sapwood** whitish, or yellowish, or reddish brown; heartwood reddish brown. **Twigs** *stout, towards apex 2–5 mm diameter*, densely tomentose with hairs 0.2–1 mm long, glabrescent; *bark not tending to crack or flake*. **Leaves** subcoriaceous, *upper surface drying olivaceous-brown, lower surface papillose, with scattered blackish dots especially on the veinlets, persistently tomentose with stellate and stellate-dendroid hairs (0.2–)0.3–1 mm long, not silky to the touch*; oblong to lanceolate, *10–36 × 3–12 cm*, base subcordate to cuneate, apex sometimes subobtuse; midrib raised above; lateral veins 12–28 pairs, more or less raised above; petiole 0.5–1.5 cm long. **Inflorescences** simple or 2(–3)-furcate, up to 1.5 cm diameter; (5–)10–40-flowered in males; flowers tomentose with hairs (0.1–)0.2–0.3 mm long. **Male flowers:** *pedicel 7–15 mm long*; bracteole caducous, attached to the pedicel at or above the middle; buds subglobose, more or less trigonous, 4–4.5 mm diameter, *inside glabrous*, greenish to yellowish; *perianth 3–4-lobed*, at anthesis clefts to the base, *at base inside without a disc*; staminal disc more or less flat, including anthers 2–3 mm diameter; anthers (10–)12–17, shortly stiped, horizontal; staminal column 0.8–1.5 mm long. **Female flowers:** *pedicel 5–8(–10) mm long*; buds obovoid, *c.* 5 mm long. **Fruits** 1–5 per infructescence, *ellipsoid or obovoid, 1.5–4 × 1–3 cm*, tomentose with hairs *c.* 0.5 mm long, late-glabrescent; dry pericarp 2–5 mm thick; *stalk 5–10 mm long*.

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak and Kalimantan).

Ecology. In well-drained as well as swampy forests, up to 600 m altitude. Flowering throughout the year; fruiting mainly in November to March.

3. **Knema curtisii** (King) Warb.

(Ch. Curtis, 1852–1928; plant collector; 1884–1903, superintendent of the Penang Botanic Garden)

Monogr. Myrist. (1897) 567; Gamble *l.c.* 240; Ridley *l.c.* 69; J. Sinclair *l.c.* (1958) 281, *l.c.* (1961) 196 (excl. var. *linguiformis*); W.J. de Wilde *l.c.* (1979) 416; Anderson *l.c.* 266; Whitmore, Tantra & Sutisna *l.c.* 268; Argent *et al.* (eds.) *l.c.* 455. **Basionym:** *Myristica curtisii* King *l.c.* 326. **Lectotype:** *Scortechini 292*, Peninsular Malaysia, Perak (hololectotype CAL; isolectotypes FI, G, K, L, SING).

Shrub or tree up to 35 m tall. **Twigs** slender, *towards apex (0.5–)1–2 mm diameter*, *yellowish*, *tomentose with greyish hairs up to 0.1 mm long*, glabrescent; *bark not cracked or flaked*. **Leaves** membranous or chartaceous, upper surface drying greenish or brown, *lower surface* finely papillose, *without brownish dots*, *at first densely tomentose with hairs c. 0.1 mm long*, *early glabrescent*; elliptic or obovate or lanceolate, *3.5–15(–20) × 1.2–4(–6.5) cm*, base mostly attenuate, apex sometimes blunt or rounded; midrib raised above; lateral veins (6–)8–14(–20) pairs, slightly raised above; petiole 0.5–2 cm long. **Inflorescences** up to 0.5 cm diameter, (2–)5–15-flowered in males; *flowers tomentose with persistent hairs 0.1–0.3 mm long*, *or partially glabrescent*. **Male flowers:** pedicel 5–11 mm long; bracteole subpersistent, attached on the pedicel at (or below or above) the middle; *buds subglobose*, often depressed, angular or not, *2.5–5(–5.5) mm diameter*, inside cream or pink; perianth at anthesis clefts to 2/3–4/5; staminal disc flat or with minute mammilla, subtriangular, including anthers 1.7–3 mm diameter; anthers 9–25(–30), sessile, closely appressed; staminal column 1–2 mm long. **Female flowers:** *buds obovoid*, 4–5 mm long; pedicel 5–10 mm long. **Fruits** 1–2 per infructescence, ellipsoid, *2–5 × 1.5–3 cm*, apex acute, or narrowed at both ends, tomentose with hairs 0.1–0.2 mm long, or *glabrescent*; *dry pericarp 1–2.5 mm thick*; *stalk 8–16 mm long*.

Distribution. Sumatra, Peninsular Malaysia and Borneo.

Notes. A complex species comprising 4 varieties with considerable differences in general habit, distribution and habitats. Three of the varieties occur in Sabah and Sarawak. Variety *amoena* J. Sinclair is endemic to Brunei.

Key to varieties

1. Leaves 5–15(–20) cm long, upper surface drying greenish, apex acute or acuminate; lateral veins distinct on both sides. Male flower buds tending to become glabrescent. Anthers 9–15...

   var. **curtisii**

   J. Sinclair, Gard. Bull. Sing. 18 (1961) 196; W.J. de Wilde *l.c.* (1979) 418, *l.c.* (1996) 383; Turner *l.c.* 360; Coode *et al.* (eds.) *l.c.* 224.

   Stem without stilt roots, sometimes with buttresses up to 50 cm high. Leaves membranous, sometimes more or less parallel-sided; lateral veins (6–)8–16(–18) pairs, intercostal venation distinct on both surfaces. Male flower buds in cross section obtuse-angular, 2.5–4 mm diameter, initially tomentose with mixed sessile stellate and dendroid hairs 0.1–0.3 mm long, glabrescent; perianth inside reddish. Fruits scurfy, 2–4.5 cm long, usually ridged; stalk 8–16 mm long.

   Sumatra, Peninsular Malaysia and Borneo (Sabah, Sarawak, Brunei and Kalimantan). In primary and secondary forests, on hill slopes, on a variety of soils, up to 1000 m altitude. Flowering and fruiting throughout the year.

   Leaves 3.5–10 cm long, upper surface drying greenish to dark brown; apex acuminate or rounded; lateral veins indistinct. Tomentum of flowers persistent or partially glabrescent. Anthers 18–25(–30)..2

2. Male flower buds with persistent tomentum of mixed sessile-stellate and dendroid hairs; angles rounded. Leaves drying greenish brown above; apex acute to acuminate......

    var. **arenosa** J. Sinclair

    (Latin, *arenosum* = sandy place; its natural habitat)

    l.c. (1961) 198, f. 6D; W.J. de Wilde *l.c.* (1979) 420. Type: *Kostermans 8653*, Borneo, Kalimantan, Nunukan Is. (holotype K; isotypes BM, BO, L, P, SING).

    Tree up to 35 m tall, without stilt roots. Leaves membranous or chartaceous, 3.5–13 cm long; base cuneate to attenuate, apex rarely somewhat obtuse; lateral veins 12–18 pairs, indistinct on both surfaces. Male flower buds in cross section rounded-angular, 3–5 mm diameter, initially tomentose with mixed stellate and dendroid hairs 0.1–0.3 mm long, glabrescent; anthers 18–23.

    Sumatra and Borneo (Sarawak and Kalimantan). In ridge forest on sandy, sandy loam or sandstone-derived soils, up to 600 m altitude. Flowering throughout the year.

   Male flower buds with tomentum of minute mainly sessile stellate hairs, tending to be partly shed or easily rubbed off; angles sharp. Leaves drying dark brown above; apex rounded or subacuminate with obtuse tip...

    var. **paludosa** J. Sinclair

    (Latin, *paludosus* = swampy place; its natural habitat)

    l.c. (1961) 201; W.J. de Wilde *l.c.* (1979) 420; Turner *l.c.* 360. Type: *Corner SFN 26155*, Singapore, Jurong (holotype K; isotypes BO, CAL, SING).

    Stilt roots usually present. Leaves usually chartaceous, 4–10 cm long; base cuneate, apex either subacute with blunt tip, or obtuse or rounded; lateral veins 6–16 pairs, faint on both sufaces. Male flower buds in cross section sharply angular, 3–5 mm diameter; initially tomentose with mixed sessile-stellate and dendroid hairs 0.1–0.2 mm long, partially tending to become glabrescent; anthers 20–30. Fruits ridged on the line of suture, 4–5 cm long; stalk *c.* 10 mm long.

    Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sarawak). Mainly in freshwater swamp forest, up to 200 m altitude. Flowering in June–October.

4. **Knema elmeri** Merr.

(A.D.E. Elmer, 1870–1942, plant collector in Sabah and the Philippines)

PEB (1929) 75; Masamune *l.c.* 302; J. Sinclair *l.c.* (1961) 202; W.J. de Wilde *l.c.* (1979) 383; Anderson *l.c.* 266; Whitmore, Tantra & Sutisna *l.c.* 268; Coode *et al.* (eds.) *l.c.* 224. **Type:** *Elmer 21527*, Borneo, Sabah, Tawau district (holotype UC; isotypes A, BM, BO, BR, C, G, K, L, M, NY, P, SING, U).

Tree up to 15 m tall, sometimes with stilt roots. **Bark** smooth or scaly or flaky, or cracked, hard; inner bark white, or reddish, or red-brown. **Sapwood** brown. **Twigs** towards apex more or less angled, 2–4(–5) mm diameter, initially tomentose with hairs 0.1–0.2 mm long, glabrescent; *bark cracked and flaky*. **Leaves** chartaceous, upper surface drying greenish, *lower surface densely tomentose with silvery to pale brown, persistent short hairs 0.1–0.2 mm long, silky to the touch*; elliptic to oblong, 12–32 × 4–13 cm, base rounded to acute; midrib sunken to prominent above; lateral veins 12–20(–25) pairs, raised or flat above; petiole 0.8–1.8 cm long. **Inflorescences** sessile, up to 0.8 cm diameter, 5–25-flowered in males; flowers tomentose with dense hairs *c.* 0.1 mm long. **Male flowers:** pedicel 7–14 mm long; bracteole subpersistent, attached to the pedicel at about the middle;

buds ovoid to depressed globose, often more or less sagged at the base, 3–4 × 4–4.5 mm, inside red or purple; perianth at sutures 0.5–0.8 mm thick, at anthesis clefts nearly to the base; staminal disc, including anthers circular, convex in the centre, 2–2.5 mm diameter; anthers 10–14, sessile to stalked; staminal column 0.5–0.8 mm long, clasped by the thickened perianth base. **Female flowers:** pedicel 1–2 mm long; bracteole attached to the pedicel at about the middle; buds ellipsoid, *c.* 6 mm long. **Fruits** 1–6 per infructescence, obovoid to ellipsoid-oblong, 2–2.5 × 1.1–1.6 cm, tomentose with hairs 0.1–0.2 mm long; dry pericarp at suture *c.* 2 mm thick; stalk 1–5 mm long.

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In primary and disturbed riverine and mixed dipterocarp forests, lower montane forest, on clay-rich soils, sandy clay soils, also on limestone, up to 1500 m altitude. Flowering and fruiting throughout the year.

5. **Knema emmae** W.J. de Wilde

(Emma van Nieuwkoop, sometime desk editor at the Rijkherbarium, Leiden, the Netherlands)

Blumea 41 (1996) 384. **Type:** *Amdjah 144*, Borneo, NE Kalimantan, G. Muru Tagal (holotype L; isotypes BO, K, SING).

Treelet up to 5 m tall. **Bark** dark brownish; inner bark brownish; sap red. **Sapwood** whitish. **Twigs** terete, *towards apex 1.5–2 mm diameter*, *initially tomentose with hairs 0.5(–1) mm long*, glabrescent; *bark lower down yellowish brown*, *not cracked or flaky*; lenticels minute. Terminal leaf buds *c.* 10 mm long, tomentose with hairs *c.* 0.5 mm long. **Leaves** *chartaceous*, *upper surface drying green-olivaceous, lower surface glabrous*, *without blackish dots*, not or only slightly papillose; elliptic-oblong or oblong-lanceolate, 12–20 × 3.5–7 cm, base short-attenuate, apex somewhat blunt or acute-acuminate; *midrib raised above*; *lateral veins* 12–15 pairs, *flat or slightly raised above*; *intercostal venation reticulate, distinct*; petiole *c.* 1 cm long. **Inflorescences** 0.1–0.2 cm diameter, 2–5-flowered; peduncle to 1.5 mm long; *flowers tomentose with persistent hairs (0.2–)0.5–0.7 mm long*. **Male flowers:** pedicel 6–7 mm long; bracteole minute, subpersistent, inserted on the pedicel slightly above the middle; buds depressed globose, *c.* 3 × 4 mm; perianth at sutures *c.* 0.5 mm thick, at anthesis clefts to *c.* 3/4(–4/5); staminal disc circular, flat, *c.* 2 mm diameter; anthers 14–15, small, sessile just below the rim of the disc; staminal column 0.5–0.8 mm long. **Female flowers:** pedicel *c.* 4 mm long; buds obovoid, *c.* 3.5 mm long. **Fruits** 2–4 per infructescence, ovoid-oblong, *2.5–3 × 1.5–1.6 cm*, apex with style remnant *c.* 1 mm long; dry pericarp 0.5(–1) mm thick; *pubescent with hairs c. 0.5 mm long*; *stalk 7–10 mm long*, with scar of bracteole at about the middle.

Distribution. Endemic to Borneo (Sabah and NE Kalimantan).

Ecology. In hill mixed dipterocarp forest, at low altitude. Flowering and fruiting in June.

6. **Knema galeata** J. Sinclair

(Latin, *galeatus* = provided with a helmet; the helmet-shaped flower buds)

Gard. Bull. Sing. 18 (1961) 211; W.J. de Wilde *l.c.* (1979) 422; Anderson *l.c.* 267; Whitmore, Tantra & Sutisna *l.c.* 268; Coode *et al.* (eds.) *l.c.* 224. **Type:** *Anderson (Md. Hasan) S. 4855*, Borneo, Brunei, Berakas FR (holotype SAR; isotypes BRUN, KEP, SING).

Tree up to 30 m tall. **Bark** rather smooth, finely flaky or fissured; inner bark brownish. **Sapwood** pink-yellow or pale brown, or whitish. **Twigs** *towards apex 4–10 mm diameter*, *yellowish*, *purplish or brown*, at first rusty tomentose with hairs 1–2 mm long, glabrescent; older bark brown, *frequently tending to crack or flake*. **Leaves** coriaceous, upper surface drying olivaceous, glossy, *lower surface early glabrescent*, *without blackish dots*, greyish; oblong to lanceolate, 15–50 × 2.5–14 cm, base usually rounded; midrib raised above; lateral veins 20–35 pairs, raised above; petiole 1.2–3(–4) cm long. **Inflorescences** borne on older twigs 1–2 cm diameter, simple or with up to 10 protuberances, up to 2 × 1 cm, (5–)10–50-flowered in males; *flowers at first tomentose with hairs 0.4–1 mm long*, *glabrescent*. **Male flowers:** pedicel (15–)20–30 mm long; bracteole subpersistent, inserted on the pedicel at about the middle; *buds mitriform*, triquetrous in cross-section, *6–10 × 9–15 mm*, inside white, pink or red; perianth lobes broad, reniform, at anthesis clefts nearly to the base; staminal disc flat or more or less convex, including anthers subtriangular, 3–5 mm diameter; anthers 14–23; staminal column 0.5–1 mm long. **Female flowers:** pedicel 12–25 mm long; *buds* subovoid, *mitriform*, *7–9 mm long*. **Fruits** (1–)2–5 per infructescence, pear-shaped and often contracted towards the base, 2–5 × 1.5–3 cm, *at first tomentose with hairs c. 0.5 mm long*, *glabrescent*; dry pericarp 2–3 mm thick; stalk 15–30 mm long.

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In primary lowland mixed dipterocarp forest, open *kerangas* forest and swamp forest, often on sandy, yellow podsolic, yellow clay, and sandy loam soils. Flowering and fruiting throughout the year.

7. **Knema glauca** (Blume) Petermann

(Latin, *glaucus* = sea-green; the lower leaf surface)

Pflanzenreich (1838–45) 294; Warburg, Monogr. Myrist. (1897) 594 (for the var. *typica* only); Merrill *l.c.* (1921) 270; Masamune *l.c.* 302; W.J. de Wilde *l.c.* (1979) 452, *l.c.* (1987) 126; Whitmore, Tantra & Sutisna *l.c.* 268; Turner *l.c.* 360; Argent *et al.* (eds.) *l.c.* 455. **Basionym:** *Myristica glauca* Blume, Cat. (1823) 111; King *l.c.* 320, *p.p.* **Type:** *Blume s.n.*, W Java (holotype L; isotype BO). **Synonyms:** *K. glaucescens* Jack var. *glaucescens auct. non* Jack: J. Sinclair *l.c.* (1958) 304, *p.p.*; *K. cinerea* (Poir.) Warb. var. *sumatrana* (Blume) J. Sinclair *l.c.* (1961) 185, Backer & Bakhuizen *f. l.c.* 140, Whitmore, TFM 1 (1972) 334.

Tree up to 30 m tall; stilt roots sometimes present, up to 1 m high. **Bark** smooth, or flaky or scaly, or sometimes cracked or peeling off in strips *c.* 10 mm wide; inner bark 5–10 mm thick, pinkish or red-brown; sap copious, pinkish. **Sapwood** whitish or cream; heartwood reddish. **Twigs** *towards apex terete or somewhat angular*, *drying brown or blackish*, *1–3.5 mm diameter*, *tomentose with minute hairs up to 0.1 mm long*, *early glabrescent*; *bark not tending to crack or flake*. **Leaves** *membranous to chartaceous*, *upper surface drying greenish to dark brown*, *lower surface glaucous or greyish*, *without dark dots*, *at first with scattered weak greyish hairs up to 0.1 mm* *long*, *early glabrescent*; *elliptic*, *lanceolate*, *to oblong-lanceolate*, *6–20(–25) × 2–5.5(–11) cm*, *base subattenuate*, rounded or subcordate; midrib more or less raised above; lateral veins 12–22 pairs, more or less raised above; *intercostal venation coarse above*; petiole 0.7–2 cm long. **Inflorescences** sessile or with peduncle up to 3 mm long, simple or 2–3-fid, up to 1.5 cm diameter; (2–)5–20-flowered in males; *flowers pubescent with persistent scale-like hairs up to 0.1 mm long*; *perianth at sutures up to 1 mm thick*. **Male flowers:** pedicel 4–10 mm long; *bracteole usually persistent*, inserted on the pedicel at or above the middle; buds subglobose, 2.5–3.5 mm diameter, inside reddish; perianth at anthesis clefts to *c*. 4/5; staminal disc flat or faintly convex, including anthers circular, 1.5–2(–2.5) mm diameter; *anthers (8–)11–15*, subsessile or stiped; staminal column 0.5–1 mm long. **Female flower:** pedicel 1–6 mm long; *buds* more or less ellipsoid, *4–6 mm long*; perianth at anthesis clefts to about halfway. **Fruits** 1–4 per infructescence, subglobose or ellipsoid, *at base not saccate*, *1.8–3(–4?) × 1.4–1.8(–2.5?) cm*, *at first pubescent with scale-like hairs up 0.1 mm long*, *early glabrescent*, leaving a finely granulate surface; dry pericarp 1.5–2.5 mm thick; *stalk 3–12 mm long*.

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, and Bali.

Ecology. In primary and degraded lowland to lower montane evergreen forests on a great variety of soils, up to 1500 m altitude. Flowering and fruiting throughout the year.

Key to varieties

Leaves membranous or chartaceous, elliptic to lanceolate. Fruit stalk 3–7 mm long; fruit drying greyish brown...

var. **glauca**

Widespread, occurring in S Thailand, Sumatra, Peninsular Malaysia, Java, Bali, and Borneo.

Leaves membranous, oblong to lanceolate. Fruit stalk 8–12 mm long; fruit drying bright brown..

var. **riparia** W.J. de Wilde

(Latin, *riparia* = frequenting riversides)

Blumea 32 (1987) 126. Type**:** *Chai S. 18949*, Borneo, Sarawak (holotype L; isotype SAR).

Tree up to 12 m. Leaves 11–22 × 2–5.5 cm. Inflorescences simple or forked, up to 0.4 cm long, sessile or with peduncle of less than 1 mm long, in males 2–6(–10)-flowered. Male flower: pedicel 8–10 mm long; buds subglobose, 3(–3.5) mm diameter; perianth at anthesis clefts to *c*. 5/6; anthers 9–13, distinctly stiped, well spaced. Fruits solitary or 2 together, ellipsoid, 2–2.5 cm long, apex sometimes somewhat acute.

Endemic to Borneo (Sarawak). Mainly in primary riverine forest, on steep slopes, up to 500 m altitude. Vernacular name: *kumpang ensluai* (Iban).

8. **Knema glaucescens** Jack

(Latin, *glaucescens* = becoming somewhat sea-green; the lower leaf surface)

Mal. Misc. 7 (1821) 35; Warburg *l.c.* (1897) 616; J. Sinclair *l.c.* (1958) 302, *p.p.*; W.J. de Wilde *l.c.* (1979) 462; Whitmore, Tantra & Sutisna *l.c.* 269; Turner *l.c.* 360; Coode *et al.* (eds.) *l.c.* 224; Argent *et* *al.* (eds.) *l.c.* 455. **Type:** *Jack s.n.*, Sumatra, Bengkulen (L). **Synonyms:** *Myristica glaucescens* (Jack) Hook. *f.* & Thomson, Fl. Ind. 1 (1855) 157, Fl. Brit. Ind. 5 (1889) 111 (for the type only); *M. geminata* Miq., Fl. Ind. Bat., Suppl. 1 (1861) 385; *K. geminata* (Miq.) Warb. *l.c.* (1897) 604, *p.p.*, Gamble *l.c.* (1912) 247, *p.p.*, Ridley *l.c.* 72, *p.p.*, Merrill *l.c.* (1921) 270, Masamune *l.c.* 302; *K. cinerea* (Poir.) Warb. var. *sumatrana auct. non* Blume: J. Sinclair *l.c.* (1961) 185, *p.p.*

Tree up to 15 m tall. **Bark** ochre–brown, nearly smooth, not or only slightly flaky. **Twigs** *towards apex terete or somewhat angular*, *1–2 mm diameter*, *tomentose with hairs c. 0.1 mm long*, glabrescent; *bark drying brown or blackish*, *not tending to crack or flake*. **Leaves** *chartaceous or subcoriaceous*, *upper surface drying greenish to brown*, *lower surface glaucescent or greyish*, *without blackish dots*, *subpersistently dense tomentose with touching or interwoven hairs 0.1–0.2 mm long* mixed with larger stellate-dendroid hairs, when shed leaving scars; *ovate to lanceolate*, *6–20 × 2–6.5(–7) cm*, *base rounded to subattenuate*; midrib flat to raised above; *lateral veins* 13–20 pairs, *usually raised above*; *intercostal venation coarse above*; petiole 0.5–1.5 cm long. **Inflorescences** up to 0.5 cm diameter; peduncle up to 2 mm long; 5–20-flowered in males; *flowers tomentose with peristent hairs 0.1–0.2 mm long*. **Male flowers:** pedicel 6–11 mm long; *bracteole early to late-caducous*, inserted on the pedicel at or slightly above the middle; *buds globose*, 2.5–3.5 mm diameter, inside cream to yellowish; *perianth at sutures 0.8–1 mm thick*, at anthesis clefts to *c.* 4/5; staminal disc flat to low-mammillate, including anthers subcircular, 1.5–2 mm diameter; *anthers 9–13(–15)*, stiped; staminal column 0.5–1 mm long. **Female flowers:** pedicel 3–6 mm long; bracteole inserted on the pedicel at or above the middle; *buds* ellipsoid-obovoid, *4–5(–5.5) mm long*; *style up to 0.5 mm long*. **Fruits** 1 or 2 per infructescence, ellipsoid to obovoid, *1.8–2.2 × 1.2–1.8 cm*, sometimes ridged, *mealy pubescent with persistent hairs 0.1–0.3 mm long*; dry pericarp *c.* 1 mm thick; *stalk (3–)4–11 mm long*.

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In lowland and hill forests on sandy, clayey and granite-derived soils, up to 500 m altitude. Flowering and fruiting throughout the year.

9. **Knema glomerata** (Blanco) Merr.

(Latin, *glomeratus* = clustered closely together into a head; the flowers)

J. Str. Br. Roy. As. Soc. 76 (1917) 81, Sp. Blanc. (1918) 151, *l.c.* (1921) 270, Enum. Philip. Flow. Pl. 2 (1923) 183; Masamune *l.c.* 302; J. Sinclair *l.c.* (1961) 219 (*p.p.*, excl. syn. *K. stenocarpa* Warb.); W.J. de Wilde *l.c.* (1979) 437, *l.c.* (1987) 125; Whitmore, Tantra & Sutisna *l.c.* 269. **Basionym:** *Sterculia glomerata* Blanco, Fl. Filip. (1837) 764; Merrill, Publ. Gov. Lab. Philip. n. 27 (1905) 24, 73. **Type:** *Merrill Spec. Blanc. 504*, the Philippines, Luzon, Batangas Prov. (holotype A; isotypes BM, BO, CAL, K, L, NY, NSW, P, US). **Synonyms:** *Sterculia decandra* Blanco, Fl. Filip. (1837) 766; *Myristica heterophylla* Fern.-Vill., Novis. Append. (1880) 178; *K. heterophylla* (Fern.-Vill.) Warb. *l.c.* (1897) 573; *K. heterophylla* (Fern.-Vill.) Warb. var. *pubescens* Warb. *l.c.* (1897) 576; *K. vidalii* Warb. *l.c.* (1897) 615; *K. gitingensis* Elmer, Leafl. Philip. Bot. 3 (1911) 1065; *K. acuminata* Merr., Philip. J. Sc. 17 (1920) 256.

Tree up to 20 m tall. **Twigs** *slender*, *towards apex 1.5–2.5(–3) mm diameter*, *tomentose with woolly hairs 0.2–0.5 mm long*, glabrescent; *bark drying brown or blackish*, *not tending* *to crack or flake*. **Leaves** *chartaceous*, *upper surface drying greenish brown*, *lower surface at first tomentose with greyish soft stellate hairs 0.1–0.3 mm long*, *glabrescent*, often the tomentum somewhat long persistent on midrib and lateral veins, *without blackish dots*; elliptic to lanceolate, 10–23(–35) × 3–7(–10) cm, base rounded to attenuate; *midrib flattish to slightly raised above*; *lateral veins* (12–)15–20(–22) pairs, *flattish above*, often brownish on lower leaf surface; *intercostal venation reticulate, faint above*, *fine but visible beneath*; petiole 0.5–1.5 cm long. **Inflorescences** sessile, up to 0.8 × 0.6 cm; 4–20-flowered in males; *flowers greyish to rusty tomentose with persistent hairs 0.2–0.5 mm long*. **Male flowers:** pedicel 4–11 mm long; bracteole caducous, minute, inserted on the pedicel at about the middle; buds depressed globose, 3–5 mm diameter, inside pink or red; perianth at sutures 0.3–0.7 mm thick, at anthesis clefts nearly to the base; staminal disc flattish or with a low mammilla, including anthers circular, 2–2.5 mm diameter; anthers 9–13 (–15), almost sessile to stiped; staminal column slender, 1–2 mm long. **Female flowers:** pedicel 2–4 mm long; bracteole almost median on the pedicel; buds ellipsoid-obovoid, *c*. 5 mm long. **Fruits** 1–3 per infructescence, globose-ellipsoid, *1.5–2.5(–3) × 1.2–2.3 cm*, *pubescent with scurfy hairs 0.1–0.2 mm long*; dry pericarp *c*.1.5 mm thick; *stalk 4–6(–10) mm long*.

Distribution. Borneo (one collection, *S. 24419*, from Sarawak), the Philippines (common) and Seram (rare).

Ecology. In primary and degraded lowland and hill forests, up to 600 m altitude. Flowering throughout the year; fruiting in June–December.

10. **Knema hirtella** W.J. de Wilde

(Latin, *hirtellus* = finely hairy; the staminal column)

Blumea 25 (1979) 459, *l.c.* (1987) 130; Whitmore, Tantra & Sutisna *l.c.* 269. **Type:** *Mikil SAN 30235*, Borneo, Sabah, Beaufort district (holotype L; isotype SAN).

Tree up to 25 m tall. **Twigs** *towards apex 2–3.5 mm diameter*, *tomentose with scurfy hairs c. 0.1 mm* (sometimes with a few emergents up to 0.3 mm) *long*, early glabrescent; *bark drying brownish or blackish*, *not tending to crack or flake*. **Leaves** *chartaceous*, *upper surface drying olivaceous to brown*, *lower surface without blackish dots*, *either with persistent tomentum comprising scattered hairs c. 0.1 mm long* or *at first tomentose with weak greyish scattered hairs 0.1–0.2(–0.3) mm long, mixed with scars of shed coarser hairs*, *glabrescent*; *oblong-lanceolate*, *(7–)10–23 × 2.5–8.5 cm*, *base rounded to attenuate*, apex acute-acuminate or subobtuse; *midrib faintly raised above*; *lateral veins* 10–22 pairs, *flattish above*; *intercostal venation reticulate*, *distinct above*; petiole 0.8–1.2 cm long. **Inflorescences** up to 0.5 cm diameter; 2–6(–10)-flowered in males; *flowers pubescent with persistent hairs up to 0.1 mm long*. **Male flowers** (only known in var. *hirtella*)**:** pedicel 4.5–7 mm long; *bracteole caducous or persistent*, inserted on the pedicel at 1–2 mm below the perianth; *buds subglobose*, 3–3.5 mm diameter, inside yellowish (?); *perianth at sutures 0.5–0.8 mm thick*, at anthesis clefts to 4/5–4/6; staminal disc more or less flat, including anthers circular, 1.5–1.7 mm diameter; *anthers 9–13(–15)*; *staminal column 1–1.5 mm long* (in var. *hirtella at base minutely hairy*). **Female flowers:** pedicel 4–7.5 mm long; *buds* long-obovoid, *4.5–6 mm long*; *style up to 0.5 mm long*. **Fruits** 1 or 2 per infructescence, ellipsoid or ovoid, *2.5–3(–3.5)* × *1.7–2.6 cm*, apex obtuse to acute, often with persistent style, *persistently pubescent with hairs up to 0.5 mm long*; dry pericarp *c.* 1.5(–2) mm thick; *stalk 4–10(–15) mm long*.

Distribution. Endemic to Borneo (Sabah, Sarawak and Kalimantan).

Ecology. In lowland and hill mixed dipterocarp forests, often on slopes and ridges, on sandy, sandstone-derived, lateritic, and clayey soils, up to 1000 m altitude. Flowering in May–July; fruiting throughout the year.

Notes. Two largely sympatric varieties can be recognized, mainly based on the tomentum and the length of the style. Male flowers are not known in var. *pilocarpa*.

Key to varieties

Twigs towards apex and terminal leaf buds tomentose with minute hairs *c.* 0.1 mm long. Fruits pubescent with stellate-dendroid hairs up to 0.1 mm long. Staminal column minutely pubescent with greyish stellate hairs towards the base……………………………………..

var. **hirtella**

W.J. de Wilde *l.c.* (1987) 131.

Leaves beneath with persistent tomentum composed of pale yellowish stellate hairs *c.* 0.1 mm long, intermixed with early shed coarser hairs which leave distinct hair scars. Style 0–0.5 mm long, persistent in fruit. Fruits obtuse at apex.

Endemic to Sabah and Sarawak.

Twigs towards apex and terminal leaf buds tomentose with rusty stellate-dendroid hairs 0.1–0.2(–0.3) mm long. Fruits, especially towards the base, tomentose with rather rough dendroid hairs *c.* 0.5 mm long...

var. **pilocarpa** W.J. de Wilde

(Latin, *pilus* = hair; Greek, *karpos* = fruit; the hairy fruit)

Blumea 25 (1979) 461, *l.c.* (1987) 131. Type: *Cockburn SAN 85084*, Borneo, Sabah, Lahad Datu district (holotype L; isotypes K, KLU, SAN, SAR).

Leaves beneath with persistent tomentum consisting of yellowish hairs 0.1(–0.2) mm long, intermixed with early shed coarser hairs which leave distinct hair scars. Style persistent in fruit, up to 0.5 mm long. Fruits obtuse to acute-acuminate at apex.

Endemic to Borneo (Sabah, Sarawak and E Kalimantan)

11. **Knema intermedia** (Blume) Warb.

(Latin, *intermedius* = in between; inference unknown)

Monogr. Myrist. (1897) 564; Gamble *l.c.* (1912) 239; Merrill *l.c.* (1921) 270; Ridley *l.c.* 68; Masamune *l.c.* 303; Corner *l.c.* 565; J. Sinclair *l.c.* (1958) 315, *l.c.* (1961) 227; Backer & Bakhuizen *f. l.c.* 140; W.J. de Wilde *l.c.* (1979) 427; Anderson *l.c.* 267; Whitmore, Tantra & Sutisna *l.c.* 269; Turner *l.c.* 360. **Basionym:** *Myristica intermedia* Blume, Rumphia 1 (1835) 187. **Type:** *Blume s.n.*, Java (holotype L; isotype K). **Synonym:** *M. corticosa* var. *decipiens* Miq., Ann. Mus. Lugd.-Bat. 2 (1865) 51.

Tree up to 30 m tall, sometimes with stilt roots. **Bark** smooth, or scaly, or flaky. **Sapwood** white or somewhat reddish. **Twigs** slender to stout, terete or more or less angled or flattened, towards apex 1.5–4(–5) mm diameter, *rusty tomentose with hairs 0.3–0.5 mm long*, *glabrescent*; *bark brown or blackish*, *not tending to crack or flake*. **Leaves** chartaceous or *coriaceous*, *upper surface drying greenish brown*, *lower surface at first densely tomentose*, *early glabrescent*, *without brownish or blackish dots*; oblong to lanceolate, 9–30(–35) × 1.5–7(–8) cm, base rounded or attenuate; *midrib raised above*; *lateral veins* 12–25 pairs, *strongly raised above*; *intercostal venation* reticulate, *raised and distinct above*; petiole 1–2.5 cm long. **Inflorescences** simple or 2–3-furcate, up to 1.5 cm diameter; peduncle up to 2 mm long; 5–25-flowered in males; *flowers pubescent with woolly hairs 0.3–0.5 mm long*. **Male flowers:** pedicel 5–13 mm long; *bracteole* subpersistent, *median to apically inserted on the pedicel*; buds subglobose, subtrigonous, (3–)4–5 × (3–)4–5 (–5.5) mm, inside cream (or pinkish?); perianth at sutures 0.3–0.4 mm thick, at anthesis clefts to 2/3–3/4; *staminal disc* subtriangular, including anthers 2–2.5 mm diameter, *provided with a conspicuous mammilla 1–1.5 mm long*; anthers 11–15. **Female flowers:** pedicel 2–8 mm long; buds obovoid, *c.* 5(–6) mm long. **Fruits** 1–4 per infructescence, ellipsoid, 2.5–4 × 1.5–2.3 cm, *pubescent with hairs 0.3–0.5 mm long* which are more or less easily rubbed off; dry pericarp 2–3 mm thick; stalk (3–)5–14 mm long.

Vernacular name. Sarawak—*kumpang daun panjang* (Iban, preferred name).

Distribution. Sumatra, Peninsular Malaysia, W Java, and Borneo (Sabah, Sarawak, S and SE Kalimantan).

Ecology. In lowland, hill and peatswamp forests, up to 1000 m altitude. Flowering and fruiting throughout the year.

12. **Knema kinabaluensis** J. Sinclair

(of Mt. Kinabalu, Sabah)

Gard. Bull. Sing. 18 (1961) 229; W.J. de Wilde *l.c.* (1979) 450; Anderson *l.c.* 267; Whitmore, Tantra & Sutisna *l.c.* 269. **Type:** *Sinclair 9224*, Borneo, Sabah, Mt. Kinabalu (holotype K; isotypes B, E, L, M, SAN, SING).

Tree up to 25 m tall. **Bark** smooth or finely and shallowly fissured; inner bark pale brown to reddish. **Sapwood** whitish, cambium reddish. **Twigs** towards apex more or less bluntly triangular, *1.5–2.5 mm diameter*, *drying blackish with yellowish rusty tomentum consisting of hairs c. 0.1 mm long*, *glabrescent*; *bark drying brownish or blackish*, *not tending to crack or flake*. **Leaves** *rigidly coriaceous*, *upper surface drying dark brown*, *lower surface greyish*, *without blackish dots*, *at first rather densely tomentose with mixed hairs up to 0.1 mm long*, *glabrescent*, usually leaving hair scars; *oblong-lanceolate*, *9–21 × 2.5–5 cm*, *base rounded or attenuate*; midrib raised above; lateral veins 12–25 pairs, raised above; *intercostal venation reticulate*, *very distinct above*; petiole 1–2 cm long. **Inflorescences** simple or bifid, up to 1.5 cm diameter; 4–10-flowered in males; *flowers tomentose with mealy hairs 0.1–0.2 mm long*. **Male flowers:** pedicel 3–6 mm long; bracteole caducous, attached to the pedicel at about the middle; buds subglobose, 2.5–3.5 mm diameter, inside pale pink to reddish; *perianth* 3(–5)-lobed, at anthesis clefts to (3/4–)4/5, *at sutures up to 1 mm thick*; staminal disc flattish, including anthers circular, *c.* 1.5(–2) mm diameter; *anthers 7–8(–10?)*, almost sessile; staminal column *c.* 1 mm long. **Female flowers:** pedicel 3–4 mm long; *buds* obovoid-oblong, *c. 5 mm long*. **Fruits**

1 or 2 per infructescence, ovoid to oblong, *2–4.5 × 1.5–3 cm*, apex usually acute-apiculate, sometimes ridged along the line of suture, *pubescent with persistent hairs 0.1–0.2 mm long*; dry pericarp 2–4 mm thick; *stalk 3–10 mm long*.

Distribution. Endemic to Borneo (confined to the Mt. Kinabalu area, Sabah).

Ecology. In hill mixed dipterocarp to upper montane forests, on ridges and slopes, along rivers, also in degraded forest, on sandstone-derived soils, at 1000–2300 m altitude. Flowering and fruiting throughout the year.

13. **Knema korthalsii** Warb.

(P.W. Korthals, 1807–1892, sometime botanist and plant collector in Indonesia)

Monogr. Myrist. (1897) 557; J. Sinclair *l.c.* (1961) 232; W.J. de Wilde *l.c.* (1979) 428; Argent *et al.* (eds.) *l.c.* 455. **Type:** *Korthals s.n.*, Borneo, Kalimantan (holotype L; isotypes CAL, S, U). **Synonyms:** *Myristica korthalsii* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 90; *K. insularis* Merr., Philip. J. Sc. 30 (1926) 394; *K. cenabrei* Merr. & Quisumbing, Philip. J. Sc. 37 (1928) 144.

Tree up to 30 m tall. **Bark** smooth or scaly, grey; inner bark *c.* 10 mm thick, soft, reddish. **Sapwood** red or white; cambium reddish or yellow; heartwood hard, brown. **Twigs** towards apex faintly angular, *2–5 mm diameter*, *at first tomentose with hairs 0.3–0.5 mm long*, glabrescent; *bark brown or blackish*, lower down smooth or striate, or *more or less tending to crack or thinly flaky*. **Leaves** *chartaceous* or thinly coriaceous, *upper surface drying greenish brown* to dark brown, *lower surface glabrescent with sparse soft stellate hairs sometimes remaining on midrib and lateral veins*, *without blackish dots*, greyish; oblong to (ob)lanceolate, 12–35 × 2.5–9(–12) cm, base cuneate or rarely rounded; *midrib slightly raised above*; lateral veins 12–40 pairs, *slightly raised above*; *intercostal venation reticulate*, *slightly raised above*; petiole (0.8–)1–2.5 cm long. **Inflorescences** simple or more or less warted, up to 0.8 cm diameter, (1–)5–20-flowered umbels in males; *flowers tomentose with hairs 0.2–0.7 mm long*. **Male flowers:** *pedicel (4–)5–13 mm long*; bracteole caducous, *attached to the pedicel at about the middle*; *buds depressed globose*, more or less obtusely trigonous in transverse section, *4–6(–7) mm diameter*, inside red; perianth at anthesis clefts to *c.* 4/5; *staminal disc* (including anthers) circular, flattish or convex or *mammillate*, 2–2.8 mm diameter; anthers 10–20; staminal column 0.7–1 mm long, more or less clasped by the thickened disk-like base of the perianth. **Female flowers:** *pedicel 1.5–2.5 mm long*; buds obovoid-oblong, 5–6 mm long. **Fruits** 1–3 per infructescence, (ob)ovoid, ellipsoid or oblong, *1.5–4 × 1–2 cm*, *tomentose with hairs 0.5–1 mm long*; dry pericarp *c.* 3 mm thick; *stalk (1–)2–6 mm long*.

Distribution. Borneo and southern parts of the Philippines.

Key to subspecies

Twig towards apex 3–5 mm diameter, older bark not flaky. Lateral veins (14–)20–40 pairs, usually clearly interarching near the leaf margin. Fruit 2–4 cm long; stalk 2–6 mm long; persistent style and stigma *c.* 1 mm long………………..….........……………………

subsp. **korthalsii**

Borneo and the southern parts of the Philippines. In primary mixed dipterocarp forests on level lands or hilly sides, on a variety of soils, up to 400 m altitude. Flowering in Borneo in July–October.

Twig towards apex 2–3 mm diameter, older bark thinly flaky. Lateral veins 12–22 pairs, faintly interarching near the leaf margin. Fruit *c.* 2 cm long; stalk 1–2 mm long; persistent stigma sessile……………………………………………………………..............……………………..

subsp. **rimosa** W.J. de Wilde

(Latin, *rimosus* = cracked; the older twig)

Blumea 43 (1998) 242. Type: *Wood SAN A 1996*, Borneo, Sabah (holotype L; isotype SAN).

Endemic to Borneo (Sabah, Sarawak). In primary lowland and hill mixed dipterocarp forest on sandy soils or leached loam over sandy soils, up to 900 m altitude. Flowering March–April, fruiting April–June.

14. **Knema kostermansiana** W.J. de Wilde

(A.J.G.H. Kostermans, 1906–1994, formerly prominent botanist at the Indonesian Forest Research Institute and Herbarium Bogoriense, Bogor, Indonesia)

Blumea 25 (1979) 455, *l.c.* (1987) 127; Whitmore, Tantra & Sutisna *l.c.* 269. **Type:** *James SAN 19047*, Borneo, Sabah (holotype L; isotypes K, SAN, SING).

Tree up to 20 m tall. **Bark** fissured, chocolate-brown to dark-brown, or dark grey; inner bark whitish brown; sap red. **Sapwood** yellowish white or brownish. **Twigs** towards apex terete, *2–4 mm diameter*, *at first tomentose with greyish hairs less than 0.1 mm long*, early glabrescent; *bark drying brown or blackish, not tending to crack or flake*. **Leaves** membranous to chartaceous, *upper surface drying olivaceous*, *lower surface greyish*, *without blackish dots*, *inconspicuously tomentose with weak hairs up to 0.1 mm long*, early glabrescent; *elliptic to oblong*, *12–30 × 5.5–12 cm*, *base shallowly cordate to broadly rounded*; midrib raised above; *lateral veins* 15–22 pairs, *sunken to flattish above*; *intercostal venation very finely reticulate*, *distinct above*; petiole 1–1.5 cm long. **Inflorescences** 2–3-furcate, up to 0.5 cm diameter; 5–10-flowered in males; *flowers tomentose with persistent, scale-like hairs less than 0.1 mm long*. **Male flowers:** pedicel 2.5–7 mm long; bracteole minute, caducous, attached to the apical part of the pedicel; *buds depressed globose*, 3–3.2 mm diameter, inside pink; *perianth at sutures up to 1 mm thick*, at anthesis clefts to *c.* 4/5; staminal disc flat to faintly mammillate, including anthers circular, 1.5–2 mm diameter; *anthers 8–12*; staminal column 0.6–0.7 mm long. **Female flowers:** pedicel 3–4 mm long; *buds* ellipsoid-oblong, more or less narrowed in the middle, *(4–)5–6 mm long*. **Fruits** 1–3 per infructescence, *oblong*, *ellipsoid-oblong to almost fusiform*, *(5–)7–8 × 2 cm*, base tapering, *apex long-tapering or beaked*, *scaly pubescent with persistent hairs less than 0.1 mm long*, appearing as if the fruits are subglabrous; dry pericarp *c.* 2 mm thick; *stalk rather stout*, *8–10 mm long*, with the bracteole scars located at slightly above the middle.

Distribution. Endemic to Borneo (Sabah and NE Kalimantan).

Ecology. In primary and logged-over riverine forests on sandstone, up to 700 m altitude. Flowering in June–October; fruiting in July–October.

15. **Knema kunstleri** (King) Warb.

(H.H. Kunstler, 1837–1887, German explorer and King's plant collector in Peninsular Malaysia)

Monogr. Myrist. (1897) 568; Gamble *l.c.* (1912) 241; Ridley *l.c.* 69; J. Sinclair *l.c.* (1958) 291, *l.c.* (1961) 236; Whitmore *l.c.* 338; W.J. de Wilde *l.c.* (1979) 468, *l.c.* (1996) 386; Anderson *l.c.* 267; Whitmore, Tantra & Sutisna *l.c.* 269; Turner *l.c.* 360. **Basionym:** *Myristica kunstleri* King, Ann. Roy. Bot. Gard. Calc. 3 (1891) 314, pl. 149. **Lectotype:** *King's Collector 4216*, Peninsular Malaysia (hololectotype CAL; isolectotypes BM, K, L).

Tree up to 30 m tall. **Bark** smooth, finely scaly, rough, or sometimes fissured, grey or reddish to dark brown; inner bark pink or reddish. **Sapwood** cream, whitish, yellow-brown or pink. **Twigs** *towards apex 1.5–3 mm diameter*, at first tomentose with hairs 0.1–0.2 mm long, glabrescent; *bark lower down not tending to crack or flake*. **Leaves** membranous to coriaceous, upper surface drying greenish to brown, *lower surface* greyish, papillose, *with dense or sparse dark dots*, *especially on the veinlets*, *subpersistently pubescent with scattered stellate hairs c. 0.1 mm long*; ovate, elliptic-oblong to oblong-lanceolate, 5–20(–28) × (1.5–)2–8.5(–10) cm, base attenuate to broadly rounded, apex subobtuse or usually acute-acuminate; midrib raised above; lateral veins 6–18 pairs, raised above; petiole 0.5–2 cm long. **Inflorescences** sometimes supra-axillary, simple or more or less forked, 0.2–0.4 cm diameter; 3–15-flowered in males, 1–5-flowered in females; peduncle up to 5 mm long; flowers pubescent with scale-like hairs 0.1–0.2 mm long. **Male flowers:** pedicel 5–11 mm long; bracteole subpersistent, attached to the pedicel at or above the middle; buds depressed globose, sometimes more or less trigonous, 2.5–3(–4) mm diameter, inside reddish or (in Sabah and Sarawak) cream; perianth at anthesis clefts nearly to the base; staminal disc flat or slightly convex, including anthers circular or somewhat triangular, 1.3–2(–3) mm diameter; anthers 8–14; staminal column 0.5–1 mm long. **Female flowers:** pedicel 2–9 mm long; buds almost obovoid, 4–5 mm long. **Fruits** 1–4 per infructescence, *broadly ellipsoid*, *1.5–4.5 × 1–2.8 cm*, pubescent with minute scale-like hairs up to 0.1 mm long; dry pericarp 1–2 mm thick; stalk 3–15 mm long.

Distribution. A variable species with 5 subspecies, distributed in Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo 2 subspecies occur, both are found in Sabah and Sarawak.

Key to subspecies

Reticulation of intercostal venation on the upper leaf surface usually prominent and distinct. Fruits 3–4 cm long...

subsp. **alpina** (J. Sinclair) W.J. de Wilde

(Latin, *alpinus* = growing in alpine zone of mountains; growing at high altitude)

Blumea 25 (1979) 471; Whitmore, Tantra & Sutisna *l.c.* 269; Coode *et al.* (eds.) *l.c.* 224. Basionym: *K. cinerea* (Poir.) Warb. var. *alpina* J. Sinclair *l.c.* (1961) 287. Type**:** *Anderson S. 4514*, Borneo, Sarawak, Marudi district, G. Mulu, path from Melinau Paku (holotype SAR; isotypes A, K, L, SAN, SING).

Stilt roots absent. Twig towards apex (1.5–)2–3 mm diameter, sometimes angular. Leaves thickly coriaceous, upper surface drying brown, lower surface glabrescent;

elliptic-oblong to oblong-lanceolate, 4–21 × 1.5–7 cm, base rounded to attenuate; lateral veins 10–18 pairs. Inflorescences sessile. Male flower: pedicel 5–8 mm long; buds *c*. 3 × 3–4 mm, inside pale yellowish; staminal disc flat or rarely shallowly convex, anthers (7–)10–14. Female flowers with pedicel 2–3 mm long. Fruits 3–4.2 (–4.5) × 2–2.8 cm; stalk (3–)5–9(–12) mm long.

Endemic to Borneo (Sabah, Sarawak, Brunei, W and S Kalimantan). In lowland mixed dipterocarp to upper montane forests on andeside-derived soils, at (100–)900–2000 m altitude. Flowering in February, June, and October–November; fruiting throughout the year.

Reticulation of intercostal venation on the upper leaf surface usually slightly prominent, distinct or indistinct. Fruits 1.7–2 cm long.......……………….................…………………

subsp. **coriacea** (Warb.) W.J. de Wilde

(Latin, *coriaceous* = leathery; the leaves)

Blumea 25 (1979) 470; Whitmore, Tantra & Sutisna *l.c.* 269; Coode *et al.* (eds.) *l.c.* 225. Basionym: *K. coriacea* Warb. *l.c.* (1897) 614. Type: *Beccari 670*, Borneo, Sarawak (FI). Synonym: *Myristica coriacea* (Warb.) Boerl. *l.c.* 92.

Stilt roots often present. Twig towards apex 2–3 mm diameter, sometimes coarsely striate, more or less angular. Leaves coriaceous, upper surface drying light brown; elliptic to oblong or ovate-oblong, 6–21 × 3–7(–7.5) cm, base usually rounded or sometimes cuneate; lateral veins 8–18 pairs. Inflorescences sessile or with stout peduncle up to 5 mm long. Male flower: pedicel 6–10.5 mm long; buds 2.2–2.5 × 2.5–3 mm; perianth inside cream (always?); anthers 10–12. Female flowers not seen. Fruits 1.7–2 × 1.4–1.6 cm; stalk 3–7(–9) mm long.

Endemic to Borneo (Sabah, Sarawak and Brunei). In primary peatswamp and *kerangas* forests, up to 100 m altitude. Flowering in April–June; fruiting in July–November.

16. **Knema latericia** Elmer

(Latin, *latericeus* = brick-red; the perianth inside)

Leafl. Philip. Bot. 5 (1913) 1815; J. Sinclair *l.c.* (1958) 278, *l.c.* (1961) 238, excl. var. *lunduensis*; W.J. de Wilde *l.c.* (1979) 395, *l.c.* 32 (1987) 115, *l.c.* 41 (1996) 388, *l.c.* 43 (1998) 245; Whitmore, Tantra & Sutisna *l.c.* 270. **Type:** *Elmer 12757*, the Philippines, Palawan (holotype A; isotypes BM, BRSL, CAL, E, G, K, L).

Shrub or tree up to 20 m tall. **Bark** brown, reddish brown, or chocolate, scaly or flaking in fairly large elongated portions, not furrowed; inner bark pink or reddish. **Sapwood** white or pale yellow, or pale brown, sometimes with streaks. **Twigs** *slender*, *towards apex (1–)2–4(–8) mm diameter*, terete or more or less angular, *roughly tomentose with hairs 0.5–2 mm long*, glabrescent; *bark longitudinally fissured and cracked*, *later on usually flaky*. **Leaves** thinly coriaceous, upper surface drying pale brown or greenish, *lower surface glabrous*, grey or whitish, not papillose; oblong to lanceolate, 6–30 × 1–9 cm, base attenuate to rounded; midrib raised above; lateral veins 9–25(–30) pairs, raised above; petiole (0.5–) 1–1.8 cm long. **Inflorescences** sessile, warted or furcate, up to 1 cm diameter, 3–20-flowered in males; *flowers pubescent with persistent hairs 0.2–0.7 mm long*. **Male flowers:** *pedicel 3–6 mm long*; *bracteole* caducous, *attached halfway to subapically on the pedicel*; *buds depressed obovoid to depressed globose*, *3–3.5 × (3–)4–4.5 mm*, *inside brick-red*; perianth at anthesis clefts to 2/3–4/5; *staminal disc* circular, *flat or more or less convex*, or low-mammillate, including anthers *c*. 2 mm diameter; anthers 9–12; staminal column *c*. 1 mm long. **Female flowers:** *pedicel up to 1.5 mm long*; bracteole subapically inserted on the pedicel; buds much larger than in males, obovoid, (4–)5–8 mm long. **Fruits** 1–4 per infructescence, broadly ellipsoid to obovoid, sometimes subglobose, (1–) 1.5–2.5(–3) × 1–2(–2.5) cm, tomentose with rough hairs 1–2 mm long; dry pericarp (1–)2–3 mm thick; stalk 2–5 mm long.

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo, and the Philippines (Palawan).

Ecology. In primary and degraded forests, on hilly sides and ridges, also in *kerangas* forest, on a variety of soils, up to 1500 m altitude. Flowering and fruiting mainly in May–October.

Notes. A variable species with three recognized subspecies, two of which are found in Sabah and Sarawak.

Key to subspecies

Tomentum of twig towards apex and of flowers dark brown or rusty. Male flower buds more or less depressed globose, often somewhat broader than long. Staminal disc usually convex or low-mammillate. Leaves 4–10 cm broad, upper surface drying dark brown to greenish brown, lower surface pale brown to grey-glaucous. Fruits variable in size, with bright brown to rusty-reddish tomentum..

subsp. **ridleyi** (Gandoger) W.J. de Wilde

(H.N. Ridley, 1855–1956, sometime botanist and former Director of the Singapore Botanic Gardens)

Blumea 25 (1979) 396, *l.c.* (1981) 223; Turner *l.c.* 360; Coode *et al.* (eds.) *l.c.* 225. Basionym: *Myristica ridleyi* Gandoger, Bull. Soc. Bot. Fr. 66 (1919) 226, *in clavi*. Type: *Ridley s.n.*, Singapore (Herb. Gandoger, Lyon). Synonyms: *K. conferta* (King) Warb. var. *borneensis* Warb. *l.c.* 580, *p.p.*; *M. conferta* King var. *borneensis* (Warb.) Boerl. *l.c.* 1.

Twig towards apex up to 8 mm diameter, variably rusty tomentose; bark of older twig usually flaky. Female flower buds 5–8 mm long; pedicel up to 1.5 mm long. Fruits (1–)1.5–3 cm long.

Peninsular Thailand, Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak and Kalimantan).

Forma *nana* W.J. de Wilde *l.c.* (1998) 246, type: *Anderson K 10* (L), from Sabah, Sarawak and Brunei, is distinct by the slender, non-flaky twigs and small, lanceolate leaves. It may be confused with *K. minima* W.J. de Wilde (*l.c.* 249) from Brunei which is distinct by the male flower buds measuring only *c.* 2 mm diameter.

Tomentum of twig towards apex and of flowers pale brown or yellowish brown. Male flower buds obovoid. Staminal disc flat or slightly convex. Leaves 2–5 cm wide, upper surface drying pale brown or pale greenish brown, lower surface usually whitish. Fruits rather small, with pale brown or yellowish brown tomentum..

subsp. **albifolia** (J. Sinclair) W.J. de Wilde

(Latin, *alba* = white, *folium* = leaf; the pale colour of the lower leaf surface)

Blumea 25 (1979) 397; Anderson *l.c.* 267; Coode *et al.* (eds.) *l.c.* 225. Basionym: *K. latericia* Elmer var. *albifolia* J. Sinclair *l.c.* (1961) 243. Type: *Sinclair 9269*, Borneo, Sabah (holotype K; isotypes A, B, E, L, M, P, PNH, SAN, SING).

Twig towards apex with fine pale brown tomentum; bark later on flaky. Female flower buds *c.* 5 mm long. Fruits subsessile, subglobose to ellipsoid, or obovoid, 1.4–2(–3.5) cm long.

Endemic to Borneo (Sabah, Sarawak and Kalimantan, including Nunukan Is.).

17. **Knema latifolia** Warb. Fig. 8.

(Latin, *latus* = broad, *folium* = leaf; broad-leaved)

Monogr. Myrist. (1897) 610; Merrill *l.c.* (1921) 271; Masamune *l.c.* 303; J. Sinclair *l.c.* (1961) 244; W.J. de Wilde *l.c.* (1979) 414; Anderson *l.c.* 267; Whitmore, Tantra & Sutisna *l.c.* 270; Coode *et al.* (eds.) *l.c.* 225; Argent *et al.* (eds.) *l.c.* 456. **Syntypes:** *Forbes 2997*, *3188*, Sumatra (B, lost; K, L); *Beccari 1991*, Borneo, Sarawak (FI, K). **Synonyms:** *K. umbellata* Warb. *l.c.* (1897) 609; *Myristica umbellata* (Warb.) Boerl. *l.c.* 92, *nom. inval.*; *K. nitida* Merr., J. As. Soc. Str. Br. 85 (1922) 190; *K. winkleri* Merr. *l.c.* (1922) 189.

Tree up to 20 m tall. **Bark** almost smooth, peeling off in narrow strips; inner bark brittle, pinkish or red, or light brown. **Sapwood** off-white, or pale yellow, or pink. **Twigs** towards apex (1–)2–3 mm diameter, *tomentose with hairs c. 0.1 mm long*, early glabrescent; *bark drying brown or blackish*, *not flaky*. **Leaves** thinly coriaceous, *upper surface drying often blackish* and shining, *lower surface often tinged reddish brown or purplish*, *at first sparsely tomentose with minute*, *stellate*, *scale-like hairs c. 0.1 mm long*, usually *early glabrescent*, *without blackish dots*; *elliptic-oblong to obovate-oblong*, (7–)10–30 × (2.5–)4.5–12.5 cm, base attenuate to rounded; midrib slightly raised above; lateral veins 8–16 pairs, rather well-spaced, slightly raised above; *intercostal venation coarsely reticulate*, *distinct above*; petiole 1.5–3 cm long. **Inflorescences** simple or 2–4-furcate, up to 0.8 cm diameter; peduncle up to 5 mm long; 5–15-flowered in males; *flowers pubescent with inconspicuous persistent hairs up to 0.1 mm long,* subglabrescent. **Male flowers:** pedicel 5–10 mm long; bracteole minute, subpersistent, subapically attached on the pedicel; buds subglobose or ovoid-trigonous, 2.5–3.5 × 3.5–5 mm, inside pale yellowish (always?); perianth at anthesis clefts to *c.* 4/5(–5/6); staminal disc conspicuously and sharply 3(–4)-angled, rather flat or slightly convex, including anthers 2–2.5 mm diameter; *anthers 3*(–4); staminal column slender, 0.5–1 mm long. **Female flowers:** pedicel (4–)5–10 mm long; buds ellipsoid-obovoid, 5–7 mm long. **Fruits** 1–2 per infructescence, globose-ellipsoid to ellipsoid-oblong, 2–3.5 × 2–3 cm, *usually somewhat flattened*, *often broadly ridged*, *and somewhat saccate at the base*, *tomentose with hairs 0.1–0.2 mm long*, *subglabrescent*; dry pericarp 2–3 mm thick*;* stalk 7–20 mm long.

Distribution. Sumatra and Borneo (Sabah, Sarawak, Brunei and Kalimantan, including Nunukan Is.).

Ecology. In primary and degraded lowland and hill mixed dipterocarp forests on loamy, clayey, sandy, acidic, and lime-containing soils, up to 500 m altitude. Flowering throughout the year; fruiting mainly in August–December.

18. **Knema laurina** (Blume) Warb.

(Latin, *laurinus* = resembling laurel trees; the leaves)

Monogr. Myrist. (1897) 606; Gamble *l.c.* 248; Merrill *l.c.* (1921) 271; Ridley *l.c.* 72; Masamune *l.c.*

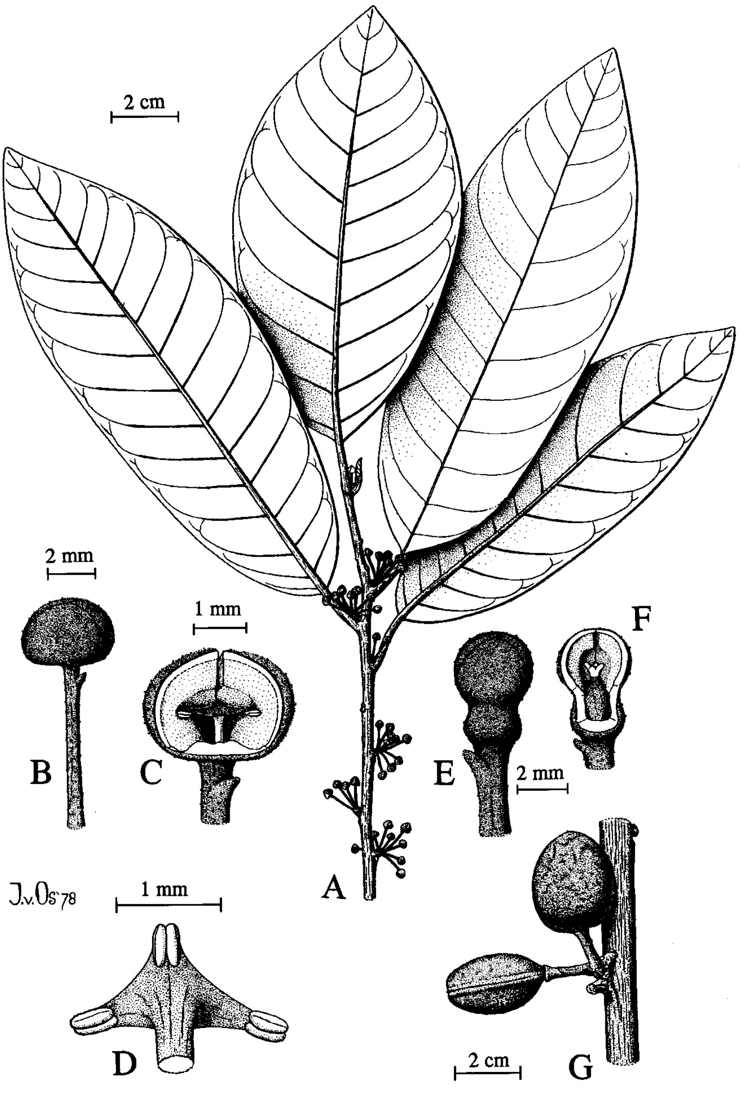

Fig. 8. *Knema latifolia*. A, flowering (male) leafy twig; B, mature male flower bud; C, opened male flower bud showing the androecium; D, androecium seen obliquely from below; E, mature female flower bud; F, opened female flower bud showing the pistil; G, infructescence. (A–D from *SAN 51920*, E–F from *S. 15642*, G from *SAN 82573*.)

303; J. Sinclair *l.c.* (1958) 329, *l.c.* (1961) 248, *p.p.*, excl. most synonyms; Backer & Bakhuizen *f. l.c.* 140; Whitmore *l.c.* 338; W.J. de Wilde *l.c.* (1979) 379; Anderson *l.c.* 267; Whitmore, Tantra & Sutisna *l.c.* 270; Turner *l.c.* 360; Coode *et al.* (eds.) *l.c.* 225; Argent *et al.* (eds.) *l.c.* 456. **Basionym:** *Myristica laurina* Blume, Rumphia 1 (1835) 189. **Type:** *Blume s.n.*, Java (L). **Synonyms:** *M. laurina* Blume var. *borneensis* Miq. *l.c.* (1865) 51; *M. cantleyi* Hook. *f.*, Fl. Brit. Ind. 5 (1886) 110.

Shrub or tree up to 30 m tall. **Bark** grey, reddish brown, or brown, smooth, finely scaly, slightly cracked, or furrowed; inner bark reddish. **Sapwood** white, yellowish, red with brown rays, light brown, or yellow with brown stripes. **Twigs** *towards apex 2–5(–6) mm diameter*, *rough tomentose with hairs 0.5–2 mm long*, late-glabrescent; *bark drying brownish or blackish*, *lower down not tending to crack or flake*. **Leaves** membranous to coriaceous, *upper surface drying greenish to brown*, *lower surface without dark dots*, finely papillose, *persistently tomentose with stiff*, *regularly set*, *equally long-stalked dendroid hairs c. 1 mm long*; obovate-elliptic to oblong-lanceolate, *9–30 × 2.5–10.5 cm*, base attenuate to rounded; midrib more or less raised above, late-glabrescent; lateral veins 12–28 pairs, flat or sunken above; petiole late-glabrescent, 1–2 cm long. **Inflorescences** subsessile, simple or 2-fid, up to 0.7 cm diameter, 5–20-flowered in males; *flowers pubescent with dense hairs 0.5–1.5(–2) mm long*. **Male flowers:** pedicel (0.5–)2–5 mm long; bracteole subpersistent or caduous, inserted on the apical part of the pedicel or nearly so; buds obovoid-oblong, 3–5(–6) × 2–4 mm, inside pink or red; perianth at anthesis clefts to *c.* 1/2; staminal disc flat or slightly concave, including anthers circular, 1–1.5 mm diameter; anthers 6–9, sessile, suberect; staminal column somewhat tapering, 1.5–2.5 mm long, glabrous or rarely minutely pubescent at the base. **Female flowers:** pedicel up to 1 mm long; buds ovoid-oblong, 4–6 mm long. **Fruits** 1–5 per infructescence, ovoid or ellipsoid-oblong, *1.5–3 × 1–2 cm*, *rusty tomentose with hairs 1–3 mm long*; dry pericarp 1.5–2 mm thick; stalk 0–1(–5) mm long.

Vernacular name. Sabah—*darah-darah kerantu* (preferred name).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, W and C Java, and Borneo. Common in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. In primary and degraded lowland to lower montane forests, on a variety of soils, up to 1500 m altitude. Flowering and fruiting throughout the year.

19. **Knema linguiformis** (J. Sinclair) W.J. de Wilde Fig. 9.

(Latin, *linguiformis* = tongue-shaped; the leaves)

Blumea 25 (1979) 416, *l.c.* (1981) 227, *l.c.* (1987) 121; Whitmore, Tantra & Sutisna *l.c.* 270; Coode *et al.* (eds.) *l.c.* 225; Argent *et al.* (eds.) *l.c.* 456. **Basionym:** *K. curtisii* (King) Warb. var. *linguiformis* J. Sinclair *l.c.* (1961) 200. **Type:** *Sinclair (Kadim & Kapis) 9294*, Borneo, Sabah, Sepilok FR, Compt. 16 (holotype K; isotypes A, B, BM, E, L, M, SAN, SING).

Tree up to 25 m tall. **Bark** smooth or almost so, or slightly scaly; inner bark soft, *c.* 5 mm thick, reddish or brown. **Sapwood** dirty white. **Twigs** *towards apex 1–2 mm diameter*, *at first tomentose with woolly hairs 0.2–0.5 mm long*, late-glabrescent; *bark lower down yellowish*, *not tending to crack or flake*. **Leaves** chartaceous, upper surface drying greenish, *lower surface* minutely papillose, *without reddish brown dots*, *early glabrescent*; oblong

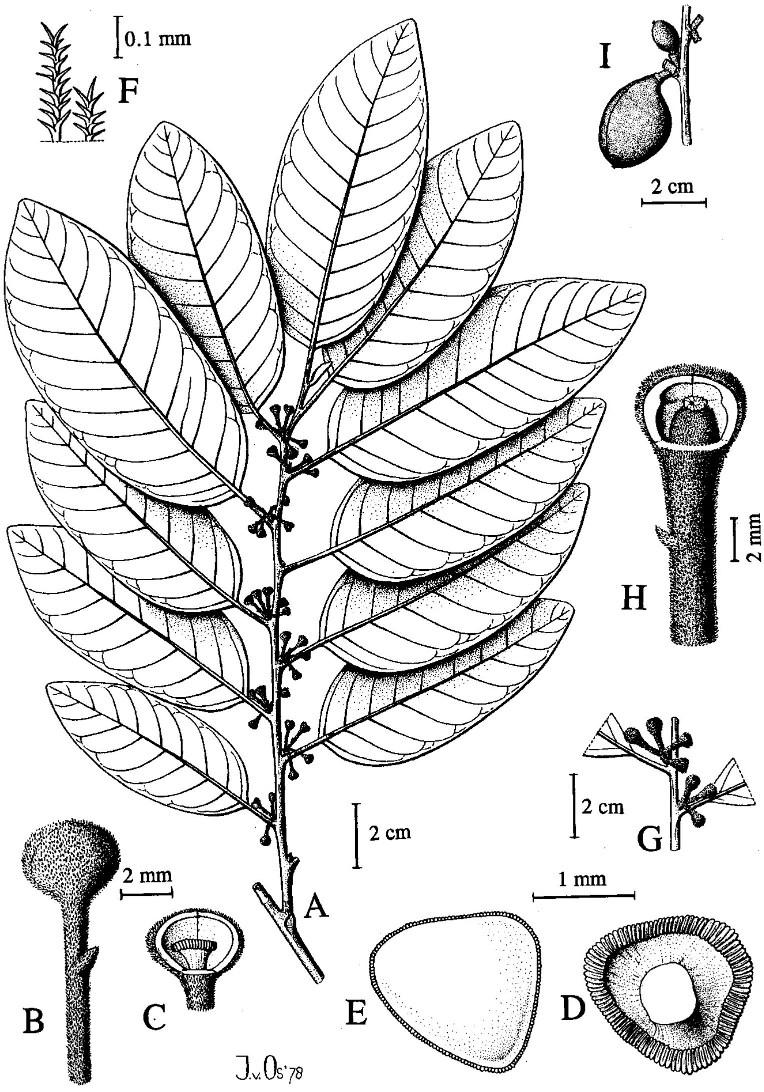

Fig. 9. *Knema linguiformis*. A, flowering (male) leafy twig; B, mature male flower bud; C, opened male flower bud showing the androecium; D, androecium seen from below; E, androecium seen from above; F, dendroid hairs of perianth of male flower; G, portion of twig with female inflorescences; H, opened mature female flower bud showing the pistil; I, infructescence with submature and immature fruits. (A–F from *S. 26978*, G–H from *S. 32290*, I from *SAN 81118*.)

to lanceolate, *5–15 × 1.5–5(–6) cm*, base attenuate to rounded, apex acute to obtuse; midrib raised above; lateral veins 8–20 pairs, raised above; petiole late-glabrescent, 0.6–1.5 cm long. **Inflorescences** sessile, simple or forked, 0.2–0.5 cm diameter; 5–20-flowered in males; *flowers tomentose with hairs (0.1–)0.2–0.3(–0.4) mm long*, glabrescent. **Male flowers:** *pedicel slender 5.5–13 mm long*; bracteole persistent, attached to the pedicel at about the middle; *buds depressed globose* to broadly obovoid, in transverse section often obtusely trigonous, *3.5–6 mm diameter*, inside pink; perianth at anthesis clefts to *c.* 3/4; staminal disc subcircular or obtusely trigonous, flat, including anthers 1.5–3 mm diameter; anthers 19–25, closely appressed, sessile, suberect, hidden under the staminal disc; staminal column tapering, 0.5–2 mm long. **Female flowers:** *pedicels slender*, *5–8 mm long*; *buds depressed globose* or obovoid, *4–6 mm long*; stigma subcircular, 8–21-lobulate. **Fruits** 1–3 per infructescence, ellipsoid to ovoid, *3.5–4 × 2–2.5 cm*, at base often contracted into a short stipe, at first tomentose with minute hairs, *glabrescent*; *dry pericarp c. 2 mm thick*; *stalk (2–)5–8 mm long*.

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In primary and degraded lowland mixed dipterocarp to lower montane forests on hillsides and ridges, on various types of soils, up to 1650 m altitude. Flowering and fruiting throughout the year.

20. **Knema longepilosa** (W.J. de Wilde) W.J. de Wilde

(Latin, *longus* = long, *pilosus* = covered with hairs; the long-hairy flowers)

Blumea 41, 2 (1996) 389. **Basionym:** *K. percoriacea* J. Sinclair f. *longepilosa* W.J. de Wilde *l.c.* (1979) 394. **Type:** *Sibat S. 22985*, Borneo, Sarawak, Limbang district, Mt. Murud (holotype L; isotypes A, K, SAN, SAR, SING).

Tree up to 10 m tall. **Bark** reddish brown; sap red. **Twigs** *towards apex 2–4 mm diameter*, looking much thicker (4–6 mm) by the dense yellow-brown or dark rusty, *shaggy hairs 2–3 mm long*, late-glabrescent; *bark finely flaky*. Terminal leaf buds short, 5(–10) × 4–5 mm, pubescent with hairs 2–4 mm long similar to those of the twig apex and petiole. **Leaves** thinly *coriaceous*, upper surface drying olivaceous, *lower surface glabrous*, greyish, with midrib and veins brown-yellow, contrasting with the leaf surface; elliptic-oblong to lanceolate, 13–25 × 3–6 cm, *base narrowly rounded or cuneate*; midrib pale and prominently raised above; lateral veins 10–15 per side, raised; petiole 1–1.5 cm long, at first densely yellow-brown or rusty pubescent with hairs 2–4 mm long, late-glabrescent, in colour contrasting with the early glabrescent leaf blades. **Inflorescences** simple or forked, up to 0.5(–1) cm diameter, late-glabrescent; 2–6-flowered in males; *flowers densely and persistently pubescent with hairs 2–4 mm long*. **Male flowers** densely yellow-brown or rusty pubescent with hairs (2–)4 mm long, appearing as mops of 6–8 mm diameter; pedicel 3–4 mm long; bracteole minute; buds subglobose, 3.5–4 mm diameter, perianth at anthesis clefts to *c.* 1/2; staminal disc flat, bluntly subtriangular, 1.5(–2) mm diameter; staminal column short, tapering, *c.* 1 mm long, glabrous; anthers 15–18, sessile, contiguous. **Female flowers** and **fruits** not known.

Distribution. Endemic to Borneo (C Sarawak, W and C Kalimantan).

Ecology. In lowland mixed dipterocarp forest on basaltic or clay soils, up to 250 m altitude. Flowering in January and April.

21. **Knema lunduensis** (J. Sinclair) W.J. de Wilde

(of Lundu area, Sarawak)

Blumea 25 (1979) 395, *l.c.* (1996) 391; Whitmore, Tantra & Sutisna *l.c.* 270; Coode *et al.* (eds.) *l.c.* 225. **Basionym:** *K. latericia* Elmer var. *lunduensis* J. Sinclair *l.c.* (1961) 244. **Type:** *Sinclair (& Kadim) 10381*, Borneo, Sarawak, Lundu district, G. Gading (holotype K; isotypes A, E, L, SAR, SING).

Tree up to 20 m tall. **Bark** flaky, or fissured, or smooth; inner bark light red. **Sapwood** white. **Twigs** *stout*, *towards apex 4–6(–10) mm diameter*, *tomentose with hairs (0.5–)1–1.5 mm long*, glabrescent; *bark longitudinally cracked and flaky*. **Leaves** *chartaceous to thinly coriaceous*, *upper surface drying brown*, *lower surface glabrous*; obovate-elliptic to oblong-oblanceolate, 15–50 × 4.5–16(–20) cm, *base obtuse to rounded*, *or subtruncate*, *or rarely subcordate*; midrib raised above; lateral veins 12–30 pairs, raised above; petiole 1–3 cm long. **Inflorescences** sessile, simple or forked, up to 1 cm diameter, 5–15-flowered in males; *flowers tomentose with persistent hairs (0.4–)0.5–1.5(–2) mm long*. **Male flowers:** pedicel 3–4 mm long; bracteole more or less persistent, attached to the pedicel slightly above the middle; *buds* depressed globose, *3–3.5(–7) × 4–5(–6) mm*, inside flesh-pink; perianth at anthesis clefts to *c.* 4/5; staminal disc flat or slightly convex, subcircular, including anthers 1.8–2 mm diameter; anthers 10–12(–14); staminal column tapering, 0.6–1 mm long. **Female flowers** not seen. **Fruits** 1–6 per infructescence, ellipsoid, *(2–)2.5–3.5(–4) × 1.5–2.5(–3.5) cm*, tomentose with coarse hairs 1–2 mm long; dry pericarp 2–4 mm thick; *stalk 0–3 mm long*.

Distribution. Endemic to Borneo (Sabah and Sarawak).

Ecology. In primary lowland mixed dipterocarp to lower montane forests, on granitic soils, at 100–1500 m altitude. Flowering in June; fruiting in June–November.

22. **Knema luteola** W.J. de Wilde

(Latin, *luteolus* = yellowish; the pale twig)

Blumea 25 (1979) 451; Whitmore, Tantra & Sutisna *l.c.* 270. **Type:** *Endert 2822*, Borneo, central E Kalimantan (holotype L).

Tree up to 20 m tall. **Bark** brownish, somewhat fissured, strongly peeling off; inner bark *c.* 3 mm thick, reddish, inside yellow. **Sapwood** pale yellowish. **Twig** *towards apex somewhat flattened or bluntly triangular*, *yellow-brown*, smooth, *1.5–2.5(–3) mm diameter, at first tomentose with minute greyish hairs up to 0.1 mm long*, early glabrescent; *bark not tending to crack or flake*. **Leaves** *chartaceous*, *upper surface drying greenish*, *lower surface greyish*, *without blackish dots*, *at first tomentose with minute, weak, grey hairs and scales*, *early glabrescent*; *oblong to lanceolate*, *12–30 × 3–9.5 cm*, *base rounded to cuneate*; midrib slender, raised above; lateral veins 16–25 pairs, not or only faintly raised above; *intercostal venation forming a very fine network*; petiole 1–1.5 cm long. **Inflorescences** simple or 2–4-fid, up to 0.5 cm diameter; 5–12-flowered in males; *flowers persistently pubescent with minute yellowish scale-like hairs up to 0.1 mm long*. **Male flowers:** pedicel 4–7.5 mm long; bracteole caducous, 1–2.5 mm long, attached on the pedicel below the perianth; *buds* globose, not depressed, *2.5–4 mm diameter*, inside yellow or pale yellow; perianth at anthesis clefts to 3/4–4/5, *at the sutures up to 1 mm thick*; staminal disc flat, including anthers circular, 1.7–2.3 mm diameter; *anthers 9–10*; staminal column *c*. 0.5 mm long. **Female flowers** not seen. **Fruits** 1–4 per infructescence, ellipsoid to ellipsoid-oblong, *3–7 × 2–2.5 cm*, *usually beaked at the apex*, *pubescent with minute scale-like hairs less than 0.1 mm long*; dry pericarp *c*. 2 mm thick; *stalk stout*, *15–20 mm long*, bracteole scar situated at or below the middle.

Distribution. Endemic to Borneo (Sarawak, W and E Kalimantan).

Ecology. In lowland and hill mixed dipterocarp forests, often on stream banks, at 100–700 m altitude. Flowering in June, August, and December; fruiting in February–March.

23. **Knema membranifolia** Winkler

(Latin, *membranus* = thin, *folium* = leaf; thin-leaved)

Engl. Bot. Jahrb. 49 (1913) 368; J. Sinclair *l.c.* (1961) 262; W.J. de Wilde *l.c.* (1979) 422; Anderson *l.c.* 267; Whitmore, Tantra & Sutisna *l.c.* 270; Coode *et al.* (eds.) *l.c.* 225. **Lectotype:** *Winkler 2460*, Borneo, SE Kalimantan (hololectotype BRSL; isolectotypes BM, BO, G, K, L, P, SING).

Tree up to 25 m tall. **Bark** thin, smooth, peeling off in thin strips, or flaky; inner bark 3–5 mm thick, brown. **Sapwood** pale brown or white. **Twigs** *towards apex 1.5–3 mm diameter*, subterete or bluntly 2–3-angular, *at first densely tomentose with hairs c. 1 mm long*, *glabrescent*; *bark yellowish*, that of older twig *smooth or usually tending to crack or flake*. **Leaves** *membranous* to thinly coriaceous, upper surface drying olivaceous, *lower surface without blackish dots*, *early glabrescent*; oblong to lanceolate, 12–28 × 3.5–8.5 cm, base attenuate to subobtuse, apex sometimes obtuse; midrib prominent above; lateral veins 12–17 pairs, distinct but hardly raised above; petiole 1.5–2.5 cm long. **Inflorescences** sessile, simple or 2–4-tubercled, up to 1 cm diameter; 5–30-flowered in males; *flowers at first tomentose with hairs 0.5–1 mm long*, *early glabrescent*. **Male flowers:** pedicel 6–9 mm long; bracteole caducous, attached to the pedicel at about the middle; *buds depressed globose*, *obtusely trigonous*, *3.5–5 × 5–7(–8) mm*; perianth at anthesis clefts to 3/4–4/5; staminal disc flat or convex, but not mammillate, including anthers circular, 3–3.5 mm diameter; anthers 19–20(–23?); staminal column 0.7–1 mm long. **Female flowers:** pedicel 1–4 mm long; *buds* broadly obovoid, *3.5–4.5 mm long*. **Fruits** 1–3 per infructescence, ellipsoid or obovoid, 2.5–4.5 × 2–3.5 cm, at first tomentose with very short hairs, *early glabrescent*; dry pericarp 1.5–2 mm thick; stalk 1–5 mm long.

Distribution. Endemic to Borneo (Sabah, Sarawak and Kalimantan).

Ecology. In lowland and hill mixed dipterocarp forests on loamy and basalt-derived soils, up to 500 m altitude. Flowering mainly in April–June; fruiting throughout the year.

24. **Knema mogeana** W.J. de Wilde

(J. Mogea, botanist of the Herbarium Bogoriense, Bogor, Indonesia)

Blumea 32 (1987) 136; Whitmore, Tantra & Sutisna *l.c.* 270. **Type:** *Mogea (& de Wilde) 4446*, Borneo, C Kalimantan (holotype L; isotype BO).

Tree up to 15 m tall. **Bark** dark brown, smooth or rough when old, with some pustules, not furrowed or striate; sap copious, red. **Twigs** *slender*, *towards apex terete*, *1–1.5 (–2) mm diameter*, *minutely pubescent or glabrescent with dull brown hairs 0.1–0.2 mm long*; *bark lower down blackish brown, not flaky*. Terminal leaf buds slender, 8–12 mm long, tomentose with hairs 0.1–0.2 mm long. **Leaves** *membranous*, *upper surface drying olivaceous* or dark brown, *lower surface greyish*, *without blackish dots*, *persistently tomentose with widely scattered, pale stellate hairs 0.1–0.2 mm across*; *oblong to lanceolate*, *8–17(–24) × 1.5–4(–7) cm*, *base narrowly rounded to attenuate*; midrib raised above; lateral veins 13–20 pairs, sunken or flatfish, sometimes raised above; *reticulation of intercostal venation faint above*; petiole 0.8–1.2(–1.5) cm long. **Inflorescences** simple or forked, up to 0.4 cm diameter, not stalked, in males 4–8-flowered; *flowers persistently tomentose*. **Male flowers** densely tomentose with hairs 0.1–0.2 mm long; pedicel slender, 2–4 mm long; *bracteole persistent*, 0.5–1 mm long, located at *c.* 0.5 mm below the perianth; *buds broadly obovoid*, *c.* (2–)2.5 mm diameter; perianth at anthesis clefts to 4/5–5/6, *at sutures up to 1 mm thick*; staminal disc circular, flat above, including anthers 1–1.5 mm diameter; *anthers 6–8*; staminal column *c.* 1(–1.4) mm long, glabrous. **Female flowers:** pedicel 3–6(–8) mm long; *buds* long-obovoid, *c. 4 mm long*. **Fruits** solitary or up to 6 per infructescence, ellipsoid to ellipsoid-oblong, *1.5–2 × 1–1.2 cm, tomentose with persistent hairs c. 0.1 mm long*; dry pericarp *c.* 1 mm thick; *stalk 4–10 mm long*.

Distribution. Endemic to Borneo (Sabah, Sarawak, C and E Kalimantan).

Ecology. In primary mixed dipterocarp forest on sandy loam soils, on hill slopes and ridges, also in *kerangas* forest on sandy soils, and on limestone, up to 300 m altitude. Flowering in December–January, and May–June; fruiting in January and June–September.

25. **Knema muscosa** J. Sinclair

(Latin, *muscosus* = moss-like; the twig apices)

Gard. Bull. Sing. 18 (1961) 264; W.J. de Wilde *l.c.* (1979) 466; Anderson *l.c.* 268; Whitmore, Tantra & Sutisna *l.c.* 270. **Type:** *Clemens 22120*, Borneo, Sarawak, Kapit district, G. Majau, Gat, upper Rejang R. (holotype K; isotypes A, BM, BO, L, NY, PNH, SAR, SING).

Tree *c.* 8 m tall. **Twigs** *slender*, *towards apex 1–1.5 mm diameter*, initially tomentose with hairs 0.2–0.7 mm long, glabrescent; *bark greyish black*, *not tending to crack or flake*. **Leaves** chartaceous, upper surface drying brown, *lower surface* brownish grey, *with scattered dark brown dots*, *at first tomentose with conspicuous sessile stellate and dendroid hairs 0.2–0.7 mm long*, *glabrescent*; oblong to oblong-lanceolate, 5.5–12(–15) × 1.5–3.5 cm, base subattenuate; midrib slender, raised above; lateral veins 7–14 pairs, slender, raised and distinct above; petiole 0.7–1 cm long. **Inflorescences** simple or 2–3-fid, up to 0.3 cm diameter, (1–)2–8-flowered in males; flowers woolly tomentose with hairs 0.2–0.5 mm long; peduncle up to 2 mm long. **Male flowers:** pedicel 2–3 mm long; bracteole minute, more or less persistent, located on the pedicel at about the middle; buds subglobose or broadly obovoid, 2–2.5 mm diameter; perianth at anthesis clefts to *c*. 3/4; staminal disc flat, including anthers circular, 1–1.3 mm diameter; anthers 6–8; staminal column 0.7–1 mm long. **Female flowers** not known. **Fruits** 1 per infructescence, *obovoid-oblong*, *1.7–1.8 × 1 cm*, apex shortly acute-mucronate, tomentose with hairs *c*. 0.3 mm long; dry pericarp *c*. 0.5 mm thick; stalk 6–7 mm long, with the bracteole scar more or less at median position.

Distribution. Endemic to Borneo (Sarawak).

Ecology. In montane mossy forest.

26. **Knema oblongata** Merr. Fig. 10.

(Latin, *oblongus* = oblong; the leaves)

J. As. Soc. Str. Br. 85 (1922) 190; Masamune *l.c.* 303; W.J. de Wilde *l.c.* (1979) 400; Whitmore, Tantra & Sutisna *l.c.* 271. **Type:** *Ramos 1663*, Borneo, Sabah, Sandakan (holotype PNH, probably destroyed; isotypes A, BM, BO, BRI, K, L, UC, US).

Shrub or tree up to 20 m tall. **Bark** smooth, sometimes scaly or slightly fissured; inner bark red-brown, beef-red, or pinkish. **Sapwood** pale yellowish, brownish, or whitish. **Twigs** towards apex 2–8 mm diameter, *at first tomentose with hairs 0.2–0.6 mm long*, *glabrescent*; *bark drying brownish or blackish*, *lower down not cracked or flaky*. **Leaves** chartaceous to coriaceous, *lower surface* finely papillose, *without reddish brown dots*, *with persistent or partially late-glabrescent tomentum consisting of mixed sessile and stalked stellate and dendroid hairs*; elliptic to oblong or lanceolate, 11–45 × 2.5–14 cm, base subattenuate to rounded, or shallowly cordate; midrib raised above; lateral veins (10–)18–26 pairs, raised to slightly sunken above; petiole late-glabrescent, 1–2.5 cm long. **Inflorescences** simple or forked, up to 0.5 cm diameter, 5–25-flowered in males; peduncle 0–4 mm long; *flowers pubescent with hairs 0.1–1(–2) mm long*. **Male flowers:** pedicel 2–8 mm long; bracteole usually caducous, attached to the pedicel at the middle or subapically; *buds* depressed globose-obovoid, *2.5–5 × 2.5–5 mm*, tapering in the lower half; perianth at sutures 0.5–1 mm thick, at anthesis clefts to 1/2–2/3(–3/4); staminal disc including anthers subcircular, 1.4–2.5 mm diameter; anthers 7–9 or 13–18(–21), sessile to slightly stiped; staminal column 1–2 mm long. **Female flowers:** pedicel 2.5–10 mm long; bracteole attached to the pedicel at or above the middle; *buds* ellipsoid to obovoid, *6–7.5 mm long*. **Fruits** 1–3 per infructescence, ovoid to obovoid, *2–3.8 × 1.5–2 cm*, *pubescent with hairs 1–1.5 mm long*; dry pericarp 2–4 mm thick; *stalk 3–10 mm long*.

Distribution. Endemic to Borneo (Sabah, Sarawak and E Kalimantan).

Ecology. In primary and degraded lowland mixed dipterocarp to lower montane forests, on various types of soils, up to 1200 m altitude. Flowering mainly in June–August; fruiting mainly in October–December.

Notes. A variable species with three subspecies, with subsp. *oblongata* the most common. All three subspecies occur in Sabah and Sarawak.

Key to subspecies

1. Tomentum of twig towards apex composed of hairs *c.* 0.2(–0.3) mm long. Lateral veins *c.* 10 pairs. Mature male flower buds *c.* 2.5 mm diameter, tomentose with hairs *c.* 0.1(–0.2) mm long..

    subsp. **parviflora** W.J. de Wilde

    (Latin, *parvus* = small, *florum* = flower)

    Blumea 25 (1979) 404. Type: *Agam SAN 31488*, Borneo, Sabah, Lahad Datu district (holotype L; isotypes BO, K, SAN).

    Twigs slender, towards apex 2–3 mm diameter, tomentose with hairs 0.1–0.3 mm long. Leaves 8–17 × 3–6.5 cm, base rounded; lateral veins *c.* 10 pairs. Inflorescences sessile. Male flowers: pedicel *c.* 2 mm long; bracteole attached to the pedicel apically; buds broadly obovoid; perianth lobes at the sutures *c.* 0.5 mm thick, at anthesis clefts to *c.* 2/3; anthers 8, shortly stiped, 0.3–0.4 mm long. Tomentum of flowers consists of hairs *c.* 0.1 mm long.

    Endemic to Borneo: Sabah, Lahad Datu district. In primary mixed dipterocarp forest on hill sides, up to 150 m altitude. Flowering in May.

   Tomentum of twig towards apex composed of hairs 0.3–0.6 mm long. Lateral veins 18–26 pairs. Mature male flower buds 3.5–5 mm diameter, tomentose with hairs 0.4–1(–2) mm long..2

2. Leaves rather narrow, oblong to lanceolate, 2–5.5 cm wide, base attenuate to obtuse. Inflorescences with peduncle 1–4 mm long. Male flower buds obovoid, *c.* 4 mm diameter; pedicel 2–3 mm long. Anthers 7–9, almost entirely sessile..............................

    subsp. **pedunculata** W.J. de Wilde

    (Latin, *pedunculatus* = provided with a peduncle; the inflorescence)

    Blumea 25 (1979) 403. Type: *Aban SAN 49195*, Borneo, Sabah, Kota Kinabalu district, Sapangar Is. (holotype L; isotypes K, SAN).

    Twigs slender, towards apex 2–3.5 mm diameter, tomentose with hairs *c.* 0.5 mm long. Leaves 11–32 × 2–5.5 cm; lateral veins *c.* 20 pairs. Male flowers obovoid, 3–4 × 3–4.2 mm; perianth at the sutures 0.3–1.5 mm thick, at anthesis clefts to 1/2 or slightly more. Tomentum of flowers consists of hairs 0.4–2 mm long. Fruits *c.* 2 cm long; stalk *c.* 6 mm long.

    Endemic to Borneo: Sabah (Beaufort, Tenom and Kota Kinabalu districts). In primary mixed dipterocarp forest on ridges and hilly sides, on yellow or brownish soils, up to 600 m altitude. Flowering in September.

   Leaves usually broader, elliptic to oblong-lanceolate, 4–14 cm wide, base usually broadly rounded to shallowly cordate, rarely subattenuate. Inflorescences sessile or with peduncle up to 1 mm long. Male flower buds 3.5–5 mm diameter; pedicel 2–8 mm long. Anthers 13–21, subsessile or shortly stiped..

    subsp. **oblongata**

    Synonym: *K. obovoidea* Merr. *l.c.* (1929) 75; Masamune *l.c.* 303.

    Twig usually stout, towards apex 2.5–8 mm diameter, tomentose with hairs 0.3–0.6 mm long. Leaves 11–45 × 4–14 cm, base sometimes shallowly cordate; lateral veins *c.* 20 pairs. Male flower buds broadly obconical, 4–5 × 3.5–5 mm; perianth lobes at the sutures 0.5–1 mm thick, at anthesis clefts to 1/2–2/3 (rarely to *c.* 3/4). Tomentum of flowers consists of hairs 0.4–1 mm long. Fruits 2–3.8 cm long; stalk 3–10 mm long.

    Distribution as the species.

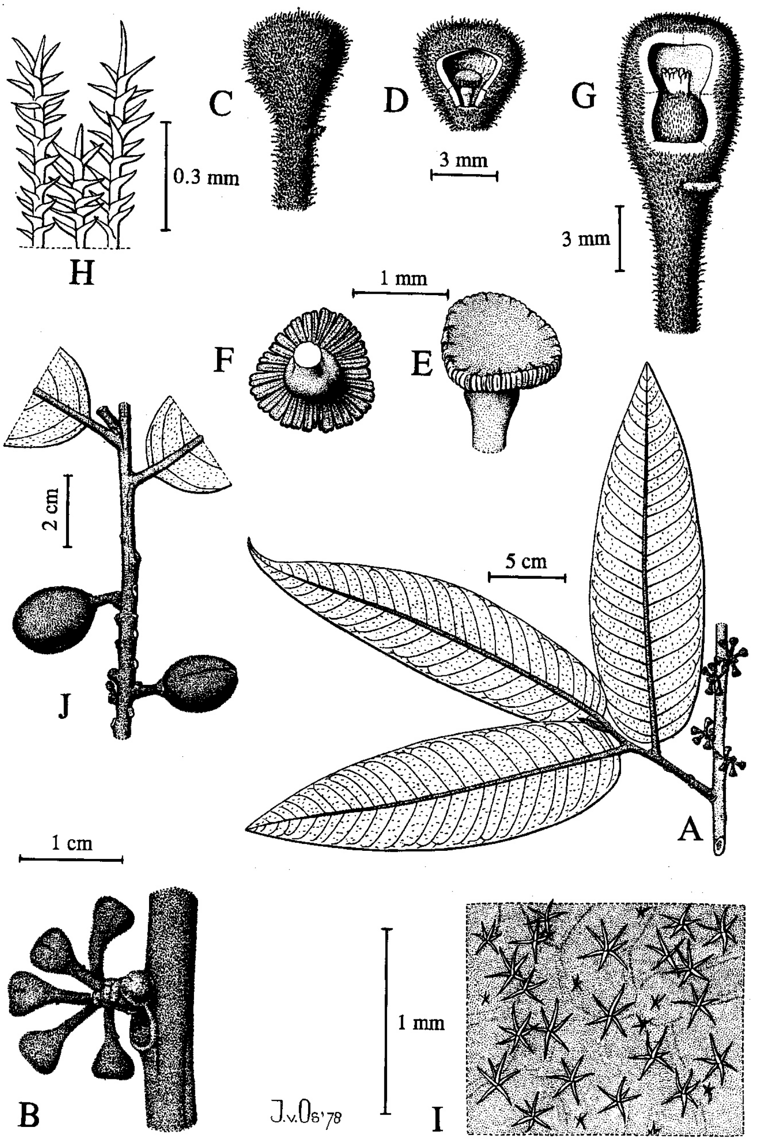

Fig. 10. *Knema oblongata* subsp. *oblongata*. A, flowering (male) leafy twig; B, male inflorescence; C, mature male flower bud; D, opened male flower bud; E, androecium in oblique view from above; F, androecium seen from below; G, opened female flower bud; H, dendroid hairs of perianth of male flower; I, detail of lower leaf surface; J, twig with infructescences, each with a single mature fruit. (A–B from *SAN 30740*, C–F, H and I from *SAN 30369*, G from *Sinclair 9291*, J from *SAN 32857*.)

27. **Knema pallens** W.J. de Wilde Fig. 11.

(Latin, *pallens* = pale; the whole plant)

Blumea 25 (1979) 391; Whitmore, Tantra & Sutisna *l.c.* 271; Argent *et al.* (eds.) *l.c.* 456. **Type:** *Saikeh SAN 73312*, Borneo, Sabah, Keningau district (holotype L; isotype SAN).

Tree up to 30 m tall. **Bark** scaly; inner bark light red or whitish. **Sapwood** yellow or yellow-ochre; heartwood dark brown. **Twigs** *stout*, subterete, *towards apex 5–12 mm diameter*, *tomentose with light brown hairs 0.2–2(–2.5) mm long*, glabrescent; *bark conspicuously longitudinally cracked and flaky*. **Leaves** subcoriaceous, upper surface drying greenish brown, *lower surface early glabrescent*, papillose; elliptic to lanceolate, 25–55 × (5–)6–23 cm, base usually cordate, apex obtuse or rounded; midrib raised above; lateral veins 18–32 pairs, raised above; petiole stout, late-glabrescent, 1–2 cm long. **Inflorescences** sessile, simple or warted, 0.5–2 cm diameter, (5–)10–30-flowered in males; *flowers pubescent with persistent yellowish hairs 0.1–0.8 mm long*. **Male flowers:** pedicel 12–20 mm long; bracteole caducous or subpersistent, attached to the pedicel at or above the middle, or almost apically; *buds* depressed globose or broadly obovoid, *6–10 × 6.5–10 mm*, inside reddish, at the basal part much thickened into a disc; perianth at anthesis clefts to 4/5 or more; staminal disc circular, flattish, including anthers 2.5–4.5 mm diameter; anthers 15–23; staminal column 1–1.5 mm long. **Female flowers:** *pedicel (7–)10–20 mm long*; buds obovoid, *c.* 11 × 8–9 mm. **Fruits** 1–6 per infructescence, ellipsoid, *3.5–7 × 2.5–3.5(–4.5) cm*, tomentose with hairs 1–2 mm long; dry pericarp 4–7 mm thick; *stalk (10–)14–30 mm long*.

Distribution. Endemic to Borneo (Sabah, Sarawak and E Kalimantan).

Ecology. In lowland mixed dipterocarp forest, also in *kerangas* forest, and forest behind mangrove, up to 300 m altitude. Flowering mainly in January–May; fruiting throughout the year.

28. **Knema pectinata** Warb.

(Latin, *pectinatus* = with comb-like divisions; the veins of the leaves)

Monogr. Myrist. (1897) 556; Masamune *l.c.* 303; J. Sinclair *l.c.* (1961) 266; W.J. de Wilde *l.c.* (1979) 430, *l.c.* (1981) 227; Anderson *l.c.* 268; Whitmore, Tantra & Sutisna *l.c.* 271. **Type:** *Beccari 1607*, Borneo, Sarawak, Kuching district (holotype FI; isotypes G, K, M, P, S).

Tree up to 25 m tall. **Bark** hard, with a few large flakes and dents where the flakes have fallen out, otherwise smooth. **Twigs** *towards apex subterete*, *grey-brown*, *3–6 mm diameter*, *at first mealy tomentose with hairs 0.1(–0.2) mm long*, *early glabrescent*; *lower down bark not tending to crack or flake*. **Leaves** *coriaceous or rigidly coriaceous*, *upper surface drying olivaceous to brown*, *lower surface without blackish dots*, *early glabrescent or with grey-brown*, *subpersistent tomentum (especially near the veins) consisting of hairs 0.1–0.3 mm long*; *oblong to lanceolate*, often more or less parallel-sided, (15–)20–45 × 3.5–10 cm, base truncate or obtuse, to attenuate, apex obtuse or acute-acuminate; midrib slightly raised above; *lateral veins 25–50 pairs*, flat to slightly raised and distinct above; petiole 1.5–2.5 cm long. **Inflorescences** simple or warted, 0.3–0.5 cm diameter, 2–6 (–10)-flowered in males; *flowers pubescent with persistent hairs up to 0.1 mm long*. **Male**

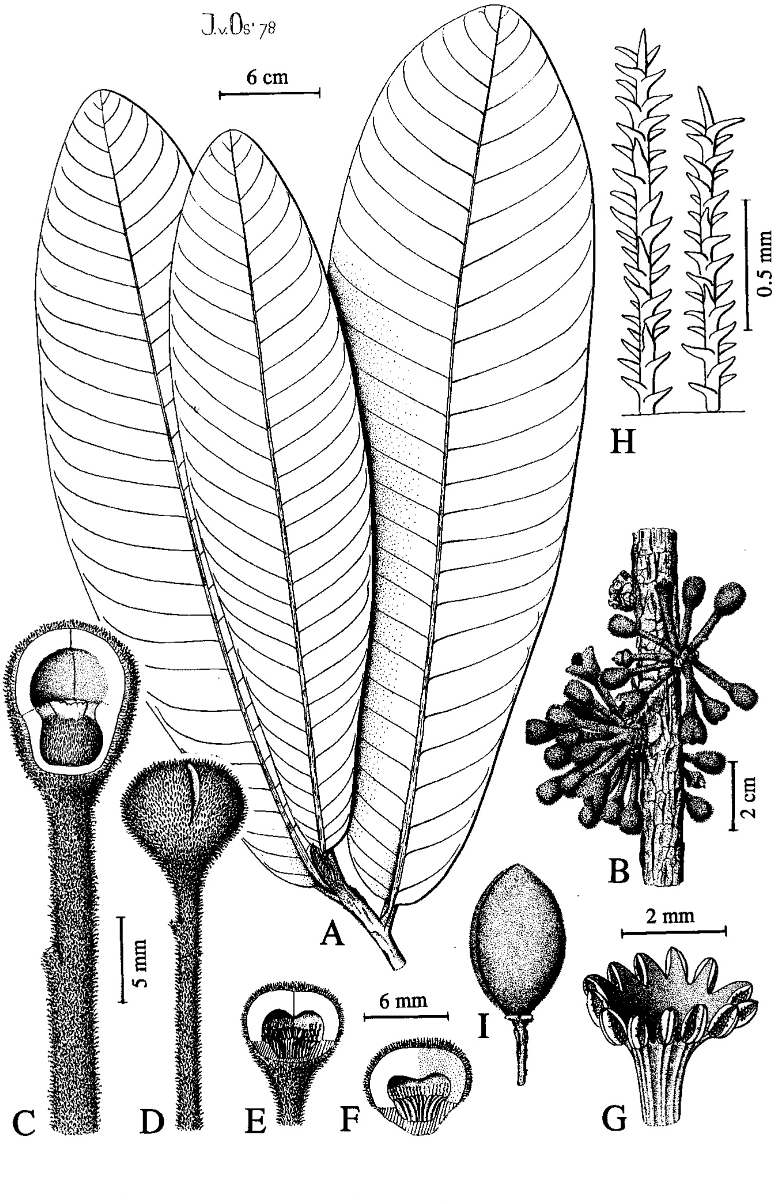

Fig. 11. *Knema pallens.* A, upper portion of leafy twig; B, portion of older branch with female inflorescences; C, opened mature female flower bud; D, mature male flower bud; E, opened male flower bud; F, opened male flower bud with the androecium removed; G, side view of androecium; H, dendroid hairs of perianth of male flower; I, fruit with remnant of tomentum on the stalk. (A–C from *SAN 73312*, D–H from *SAN 29851*, I from *S. 32964*.)

flowers: pedicel 5–15 mm long; bracteole caducous, attached to pedicel at about the middle; buds broadly obovoid or depressed globose, (3.5–)4–7 mm diameter, inside pale pink; *perianth* at anthesis clefts to 3/4–4/5, *at the sutures 1–2 mm thick*; staminal disc flattish, including anthers circular to subtrigonous, 2–4 mm diameter; *anthers 11–15*; staminal column slender, 1–2 mm long, clasped by the fleshy base of the perianth. **Female flowers** not seen. **Fruits** 1–2 per infructescence, ellipsoid to subglobose-obovoid, *3–4.5 (–5) × 1.7–3 cm*; dry pericarp 2–4 mm thick, *tomentose with hairs c. 0.2 mm long*; *stalk 2–10 mm long*.

Distribution. Endemic to Borneo (Sabah and Sarawak).

Ecology. In hill mixed dipterocarp to lower montane forests, at (400–)500–1600 m altitude. Flowering and fruiting in June–October.

Key to subspecies

Leaves coriaceous; tomentum of lower surface inconspicuous, subpersistent to glabrescent, consisting of rather weak scattered minute stellate hairs of various size; intercostal venation fine and distinct above. Fruit flanged along the line of suture or not..............................

subsp. **pectinata**

Common in Sabah and Sarawak, at 400–1500 m altitude.

Leaves rigidly coriaceous; tomentum of lower surface largely persistent, consisting of densely set, yellowish rusty, minute stellate hairs 0.1–0.2 mm long, mixed with fewer emergent ones; intercostal venation distinct on both surfaces. Fruit not flanged..

subsp. **vestita** W.J. de Wilde

(Latin, *vestitus* = clothed)

Blumea 27 (1981) 228. Type: *Ilias S. 26349*, Borneo, Sarawak, Lawas district (holotype L; isotypes K, SAR, SING).

Twig stout, towards apex 3–5 mm diameter, rusty puberulous with minute stellate, scale-like hairs up to 0.1 mm long. Leaves elliptic-oblong to lanceolate, (10–)20–30 × (3–)3.5–10.5 cm, base rounded to cuneate, apex obtuse to acute-acuminate; lateral veins 25–30 pairs. Fruits 1 per infructescence, 3–4 × 2.7–3 cm, tomentose with hairs 0.1–0.2 mm long; stalk *c.* 3 mm long.

Endemic to Borneo: Sarawak (Lawas, Ulu Limbang), at 1400–1600 m altitude.

29. **Knema pedicellata** W.J. de Wilde Fig. 12.

(Latin, *pedicellatus* = provided with a pedicel; flowers with long pedicels)

Blumea 25 (1979) 474; Whitmore, Tantra & Sutisna *l.c.* 271. **Type:** *Ilias S. 16626*, Borneo, Sarawak, Miri district, G. Lambir (holotype L; isotypes A, K, SAR).

Tree up to 30 m tall; buttresses up to 50 cm tall, 30 cm wide. **Bark** smooth or flaky; inner bark brownish; sap pinkish to dark red. **Sapwood** whitish. **Twigs** *rather stout*, towards apex terete, *4–6 mm diameter*, at first tomentose with hairs 0.5–1 mm long, glabrescent; *bark not or only rarely tending to crack or flake*. **Leaves** *chartaceous*, *upper surface* glabrescent except part of the midrib, *drying olivaceous-brown*, *lower surface* greenish

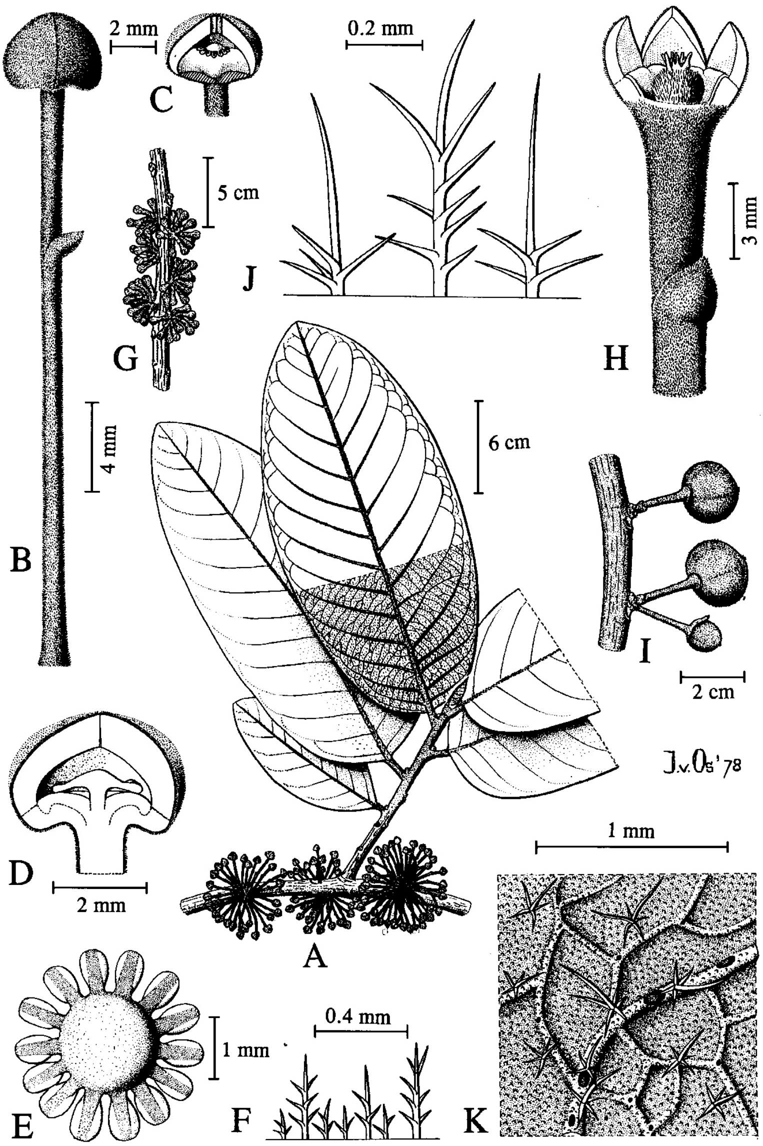

Fig. 12. *Knema pedicellata*. A, flowering (male) leafy twig; B, mature male flower bud; C, opened mature male flower bud; D, longitudinal section of mature male flower bud; E, androecium seen from above; F, dendroid hairs of perianth of male flower; G, portion of twig with female inflorescences; H, opened mature female flower bud; I, portion of branchlet with infructescences bearing submature fruits; J, dendroid hairs of lower leaf surface; K, detail of lower leaf surface. (A–F, J and K from *Ilias S. 16626*, G–H from *S. 34477*, I from *S. 16682*.)

grey, papillose, *with reddish brown dark dots predominantly on the finer veins*, *subpersistently tomentose with stout stellate and stellate-dendroid hairs 0.3–1.2 mm long*; elliptic to oblong, *(12–)17–36 × (5–)7–13 cm*, base cordate to subcuneate; midrib slightly raised above; lateral veins 14–22 pairs, slightly raised above; petiole late-glabrescent, 0.6–1.8 cm long. **Inflorescences** simple or forked, 0.4–0.8 cm diameter; 20–50-flowered in males, 10–40-flowered in females; flowers pubescent with hairs 0.1–0.5(–0.8) mm long. **Male flowers:** *pedicel slender, 20–30 mm long*; bracteole 1 (or 2), persistent, attached to the pedicel at about the middle; *buds* depressed globose, more or less sagged at the base, 3–4 × 4–5 mm, *inside glabrous*, reddish?; *perianth (3–)4–5-lobed*, at anthesis clefts to 3/4–4/5, *at the base inside with a conspicuous disc surrounding the staminal column*; staminal disc distinctly mammillate, including anthers circular, 2–3 mm diameter; anthers 14–18; staminal column 0.6–1 mm long. **Female flowers:** *pedicel 10–12 mm long*; *buds* ellipsoid–obovoid, *c*. 6 mm long, *inside with a disc at the base*; perianth lobes 4–5. **Fruits** 1–4 per infructescence, *subglobose*, *2–3 × 2.5–2.8 cm*, *usually somewhat broader than long*, tomentose with hairs 0.3–0.5 mm long; dry pericarp 4–5 mm thick; *stalk 18–30 mm long*.

Distribution. Endemic to Borneo (Sabah and Sarawak).

Ecology. In lowland and hill mixed dipterocarp forests on sandstone-derived, brownish soils, sandy soils, or sandy clay soils derived from granite, up to 700 m altitude. Flowering in May–July; fruiting in November–December.

30. **Knema percoriacea** J. Sinclair

(Latin, *per-* = exceedingly, *coriaceous* = leathery; the thick-leathery leaves)

Gard. Bull. Sing 18 (1961) 268; W.J. de Wilde *l.c.* (1979) 392, *l.c.* (1996) 392; Anderson *l.c.* 268; Whitmore, Tantra & Sutisna *l.c.* 271; Argent *et al.* (eds.) *l.c.* 456. **Type:** *Kostermans 9945*, Borneo, E Kalimantan, Loa Djanan, W Samarinda (holotype K; isotypes BO, L, SING).

Tree up to 25 m tall. **Bark** smooth, fissured, scaly or flaky; inner bark inside red-brown or pinkish. **Sapwood** usually white, sometimes reddish or red-brown. **Twigs** *stout*, subterete, *towards apex 3–6 mm diameter*, *at first tomentose with hairs 0.5–1.5(–2) mm long*, late-glabrescent; bark greyish brown, *slightly to distincly longitudinally cracked and flaky*. **Leaves** chartaceous to *coriaceous*, *upper surface drying olivaceous-brown*, *lower surface glabrous*, without blackish dots; oblong-lanceolate, 12–40 × 2.5–9(–15) cm, *base attenuate to rounded*, apex sometimes subobtuse; midrib prominently raised above; lateral veins15–25 pairs, raised above; petiole sometimes somewhat pulvinate, late-glabrescent, 0.7–2.5 cm long. **Inflorescences** simple or 2-furcate, up to 1.5 cm diameter, 10–20-flowered in males; peduncle up to 2 mm long; *flowers tomentose with persistent hairs 0.5–2 mm long*, sometimes partially glabrescent. **Male flowers:** pedicel 3–4.5 mm long; bracteole usually persistent, attached to the pedicel at or above the middle; *buds* depressed globose-obovoid, *(3.5–)4–5.5 × (3.5–)4–5.5 mm*, inside red; perianth at anthesis clefts to 2/3–3/4; staminal disc circular to subtriangular, flat, including anthers 2–2.5 mm diameter; anthers 10–18, subsessile. **Female flowers:** *pedicel 2–4 mm long*; buds ovoid-ellipsoid, 6.5–8(–9) mm long. **Fruits** 1–2 per infructescence, broadly ellipsoid, *3–4.5 × 2.5–3.5 cm*, tomentose with hairs 1–2 mm long; dry pericarp *c*. 4 mm thick; *stalk 2–3 mm long*.

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, NE and E Kalimantan).

Ecology. In primary and degraded mixed dipterocarp forests, on hill sides and ridges, on sandy, clayey and sandy loam soils, up to 700 m altitude. Flowering and fruiting mainly in July–November.

Notes. A variable species, in which three forms are distinguished. Two forms occur in Sabah and Sarawak, mostly found in *kerangas* forest.

Key to forms

Leaves chartaceous; reticulation of intercostal venation distinct on both surfaces. Tomentum of twig towards apex pale brown or yellowish brown, comprising hairs 0.3–1 mm long. Anthers 11–14..

forma **sarawakensis** W.J. de Wilde
(of Sarawak)

Blumea 25 (1979) 393; Coode *et al.* (eds.) *l.c.* 226. Type: *Wright S. 23889*, Borneo, Sarawak, Kapit district (holotype L; isotypes A, BO, K, KEP, MEL, SAN, SAR, SING).

Twigs towards apex 4–6 mm diameter, coarsely striate; bark lower down distinctly and coarsely flaky.

Endemic to Borneo: Sarawak, Brunei, Sabah, NE and C Kalimantan (Nunukan Is.).

Leaves coriaceous; reticulation of intercostal venation on both surfaces indistinct. Tomentum of twig towards apex chocolate to dark brown, comprising hairs 1–2 mm long. Anthers 15..

forma **fusca** W.J. de Wilde
(Latin, *fuscus* = dark brown; the indumentum)

Blumea 25 (1979) 394; Coode *et al.* (eds.) *l.c.* 225. Type: *Ashton BRUN 5164*, Borneo, Brunei (holotype L; isotypes BO, K).

Twig towards apex *c.* 6 mm diameter, flaky, dark brown tomentose with hairs *c.* 1.5 mm long.

Endemic to Borneo: Sarawak and Brunei.

31. **Knema piriformis** W.J. de Wilde

(Latin, *pirus* = pear; *forma* = shape; the pear-shaped male flower buds)

Blumea 25 (1979) 400; Whitmore, Tantra & Sutisna *l.c.* 271. **Type:** *Meijer SAN 34619*, Borneo, Sabah, Ranau district (holotype L; isotypes K, SAN).

Tree up to 12 m tall. **Twigs** *somewhat angular*, *towards apex 1.5–3 mm diameter*, *drying brown or blackish*, *tomentose with hairs c. 0.1(–0.2) mm long*, glabrescent; *bark not tending to crack or flake*. **Leaves** *thinly coriaceous*, *upper surface drying olivaceous*, with scattered hair scars, *lower surface without blackish dots*, *tomentose with soft greyish hairs c. 0.1 mm long*, *early to rather late-glabrescent*, sometimes mixed with larger dendroid hairs which are early shed and leaving scars; *oblong to lanceolate*, *15–25 × 3–7 cm*, *base rounded to attenuate*; midrib sunken to slightly raised above; lateral veins 20–25 pairs, sunken to flattish above; petiole 0.8–1.5 cm long. **Inflorescences** sessile, simple or forked, up to 0.6 cm diameter, 5–10-flowered in males; *flowers persistently pubescent with hairs 0.1–0.2 mm long*. **Male flowers:** pedicel 2–5 mm long; *bracteole minute*, *caducous*, situated on the pedicel at or above the middle; *buds pear-shaped*, 4–5 × 3–4 mm, *tapering in* *the lower half*, inside yellow; *perianth at the sutures up to 1 mm thick*, at anthesis clefts to 1/2–2/3; staminal disc flat, including anthers circular, 1.5–2 mm diameter; *anthers 11–12*; staminal column slender, 1.5–2.2 mm long. **Female flowers** not seen. **Fruits** 1–2 per infructescence, ovoid to ellipsoid, *2.4–2.6 × 1.5–1.7 cm, pubescent with persistent grey hairs c. 0.1 mm long*; dry pericarp *c.* 2 mm thick; *stalk c. 6 mm long*.

Distribution. Endemic to Borneo (Sabah and Sarawak; mainly found in Mt. Kinabalu and its vicinity).

Ecology. In hill mixed dipterocarp to montane forests, at (400?–)1000–2000 m altitude. Flowering in April–July; fruiting in January.

32. **Knema psilantha** W.J. de Wilde

(Greek, *psilo* = bare or smooth, *anthos* = flower)

Blumea 25 (1979) 391, *l.c.* (1996) 392; Whitmore, Tantra & Sutisna *l.c.* 271. **Type:** *Anderson S. 14373*, Borneo, Sarawak, Kapit district (holotype L; isotypes K, SAR).

Tree up to 10 m tall. **Bark** smooth, finely lenticellate, brittle; inner bark white mottled with reddish. **Twigs** fairly stout, sometimes angled, towards apex 3–5 mm diameter, tomentose with woolly yellowish brown hairs 0.5–1 mm long, soon glabrescent; *bark cracked and flaky*. **Leaves** thinly coriaceous, upper surface drying greenish brown, *lower surface glabrous*, finely papillose, without blackish dots; lanceolate, 20–48 × 3.5–9.5 cm, base obtuse to broadly rounded; midrib raised above; lateral veins 30–35 pairs, raised above; petiole late-glabrescent, 0.5–1.5 cm long. **Inflorescences** sessile, simple or warted, 0.2–0.5 cm diameter, 5–25-flowered in males, 1–5-flowered in females; *flowers tomentose with pale hairs 0.5–0.7 mm long*, *early glabrescent* in the upper half or more. **Male flowers:** pedicel 2–3 mm long; bracteole subpersistent, attached about halfway or on the upper part of the pedicel; buds ellipsoid-obovoid, 4.5–5 × 3–3.5 mm, inside red; perianth at anthesis clefts to 3/4–4/5; staminal disc flattish, including anthers circular, *c.* 1.5 mm diameter; anthers 6–7, stiped; staminal column 1–1.2 mm long. **Female flowers:** pedicel 1–2 mm long; buds larger than that of male flowers, ovoid, 8–9 mm long. **Fruits** 1–3 per infructescence, subellipsoid, 2.5–3 × 2 cm, *pubescent with persistent rough yellowish hairs c. 1 mm long*; dry pericarp *c.* 3 mm thick; stalk *c.* 2 mm long.

Distribution. Endemic to Borneo (Sabah, Sarawak and E Kalimantan).

Ecology. In mixed dipterocarp forest on ridges and hill sides, at 50–300 m altitude. Flowering in August–September; fruiting in June.

33. **Knema pubiflora** W.J. de Wilde

(Latin, *pubeus* = soft-hairy, *florus* = flower; flowers hairy inside)

Blumea 25 (1979) 466; Whitmore, Tantra & Sutisna *l.c.* 271; Argent *et al.* (eds.) *l.c.* 456. **Type:** *Meijer SAN 25105*, Borneo, Sabah, Beluran district (holotype L; isotypes BO, L, SAN, SING).

Tree up to 40 m tall; buttresses up to 2 m high, extending to *c.* 30 cm. **Bark** smooth, or when old peeling off in soft irregular small scales; inner bark chocolate, or brown, or reddish; sap reddish. **Sapwood** reddish white, or pale brown, or pale pinkish. **Twigs** *towards apex 1.5–3 mm diameter*, at first tomentose with scurfy hairs 0.1–0.2 mm long, glabrescent; *bark not tending to crack or flake*. **Leaves** chartaceous to thinly coriaceous, *upper surface drying dark brown*, *lower surface* grey-brown, papillose, *with scattered dark dots especially on the veinlets*, *at first tomentose with mixed sessile and dendroid hairs 0.2–0.5 mm long*, *late-glabrescent or persistent*; ovate-oblong to oblong, *4–15 × 1.5–7 cm*, base rounded to subattenuate; midrib slightly raised above; lateral veins 7–14 pairs, slightly raised above; petiole late-glabrescent, 0.5–1 cm long. **Inflorescences** simple or forked, up to 0.4 cm diameter; 5–20-flowered in males, 3–10-flowered in females; peduncle up to 2 mm long; flowers outside brown tomentose with hairs *c.* 0.1 mm long. **Male flowers:** pedicel 10–15 mm long; bracteole persistent or late-caducous, attached to the pedicel at above the middle; *buds* depressed globose, 2–2.5 × 2.5–3 mm, *inside densely hairy*; perianth at anthesis clefts to 3/4 or 4/5; staminal disc convex, including anthers circular, 1.2–1.5 mm diameter; anthers 11–13; staminal column 0.3–0.6 mm long. **Female flowers:** pedicel 7–10 mm long; buds obovoid, 3–4 mm long. **Fruits** 1–5 per infructescence, *subglobose to shortly ellipsoid*, *1.5–2.2(–2.5) × 1.5–2.3 cm*, often ridged at one side, tomentose with hairs 0.1–0.2 mm long; dry pericarp *c.* 1.5 mm thick; stalk 10–14 mm long.

Distribution. Endemic to Borneo (Sabah, Sarawak and Kalimantan, including Nunukan Is.).

Ecology. In mixed dipterocarp forests on sandy, sandy clay, or sandy loam soils, on hill sides and ridges, up to 300 m altitude, scattered but locally common. Flowering and fruiting throughout the year.

34. **Knema pulchra** (Miq.) Warb.

(Latin, *pulcher* = beautiful; inference unclear)

Monogr. Myrist. (1897) 600; Merrill *l.c.* (1921) 271; Masamune *l.c.* 303; W.J. de Wilde *l.c.* (1979) 399, *l.c.* (1981) 224; Whitmore, Tantra & Sutisna *l.c.* 271; Turner *l.c.* 361; Coode *et al.* (eds.) *l.c.* 226. **Basionym:** *Myristica pulchra* Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1865) 51. **Type:** *Korthals s.n.*, Borneo, Kalimantan (L). **Synonyms:** *K. glaucescens* Jack var. *cordata* J. Sinclair *l.c.* (1958) 310; *K. cinerea* (Poir.) Warb. var. *cordata* (J. Sinclair) J. Sinclair *l.c.* (1961) 181.

Tree up to 15 m tall; stilt roots sometimes present. **Bark** with a few lenticels, not flaking or pustulate, or finely fissured, or smooth; inner bark orange-brown. **Sapwood** pale brown or white. **Twigs** *towards apex 3–6(–8) mm diameter*, *tomentose with short hairs c. 0.1 mm long*, glabrescent; *bark not tending to crack or flake*, *drying brownish or blackish*. **Leaves** chartaceous to thinly coriaceous, *upper surface drying olivaceous-brown*, often glossy, *lower surface greyish*, *without blackish dots*, *with persistent or deciduous tomentum of scattered pale stellate hairs 0.1–0.2 mm long*; *elliptic-oblong to oblong-lanceolate*, *(20–)30–50 × (6–)10–17 cm*, *base rounded to cordate*; midrib raised above; *lateral veins* 18–25 pairs, *flat or hardly raised above*; petiole stout, 1.5–4 cm long. **Inflorescences** sessile, simple or 2–3-furcate, up to 1 cm diameter, 1–10-flowered in males, 1–5-flowered in females; *flowers tomentose with greyish hairs up to 0.1 mm long*; *perianth at the* *sutures up to 1 mm thick*. **Male flowers:** pedicel 4–8 mm long; bracteole caducous or subpersistent, situated at about or above the middle of the pedicel; *buds pear-shaped*, (3–)4–5.5 × 3–5 mm, inside cream or pale brown; perianth at anthesis clefts to 1/2–3/4; staminal disc flat to concave, including anthers circular to faintly triangular, 1.8–3 mm diameter; *anthers 12–25*; staminal column 0.8–1.5 mm long. **Female flowers:** pedicel (2–)5–8 mm long; *buds* obovoid-oblong, *5–6 mm long*. **Fruits** 1–2 per infructescence, *subglobose to ellipsoid-oblong*, *(3–)4–6 × 2–3.5 cm*, *apex rounded*, *glabrescent or tomentose with hairs (0.1–)0.2 mm long*; dry pericarp 3–4 mm thick; *stalk (2–)5–12 mm long*.

Distribution. Peninsular Malaysia and Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In primary lowland and hill mixed dipterocarp forests, also in swamp forest, on sandy, loamy and basalt-derived soils, up to 1000 m altitude. Flowering in May–September; fruiting in March–August.

35. **Knema riangensis** W.J. de Wilde

(of the Riang R., C Kalimantan)

Blumea 32 (1987) 138; Whitmore, Tantra & Sutisna *l.c.* 272. **Type:** *Veldkamp 7941*, Borneo, C Kalimantan, Upper Samba R., Bt. Raya area, estuary of Riang R. (holotype L; isotype BO).

Tree up to 12 m tall. **Twigs** *towards apex terete*, *1.5–3(–4) mm diameter*, more or less angular, *drying brownish black*, *tomentose with minute*, *yellowish or greyish white hairs c. 0.1 mm long*; *bark not flaky*. Leaf buds slender, 10–20 mm long, tomentose with hairs *c*. 0.1 mm long. **Leaves** *membranous*, *upper surface early glabrescent*, *drying olivaceous*, *lower surface greyish*, *without blackish dots*, *with subpersistent tomentum consisting of densely set*, *almost touching, pale stellate*, *yellowish or greyish white hairs c. 0.1(–0.2) mm long*; *elliptic-oblong to oblong-lanceolate*, *14–30 × 5–10.5 cm*, *base short-attenuate to rounded*; midrib raised above; *lateral veins* 15–23 pairs, *flattish to raised above*; petiole late-glabrescent, 1–2 cm long. **Inflorescences** simple or forked, up to 0.5 cm diameter, stalks up to 1 mm long, in males 2–6-flowered, in females 2–4-flowered; *perianth at the sutures up to 1 mm thick*. **Male flowers** *tomentose with yellowish or greyish white hairs c. 0.1(–0.2) mm long*; pedicel 3–4 mm long; *bracteole persistent*, *c*. 0.5 mm long, attached to the pedicel below the perianth; *buds broadly obovoid*, *c. 2 × 1.7 mm*, inside pink; perianth at anthesis clefts to 5/6; staminal disc subcircular to faintly triangular, flat above, including anthers 0.8–1 mm diameter; *anthers 9*; staminal column tapering (obconical), *c*. 0.8 mm long, glabrous or with a few minute hairs at the base. **Female flowers** rather stout, pedicel 5–12 mm long; *buds* almost obovoid, *4–7 mm long*. **Fruits** 1 or 2 per infructescence, ellipsoid, *2.4–4 × 1.7–2.5 cm*, *tomentose with persistent yellowish or greyish white hairs c. 0.1 mm long*; dry pericarp 1–2 mm thick; *stalk 8–12 mm long*. **Seeds** ellipsoid, 2–2.5 cm long.

Distribution. Endemic to Borneo (Sarawak and C Kalimantan).

Ecology. In primary riverine mixed dipterocarp forest on yellow sandy clay soils, at 100–600 m altitude. Flowering in January–February; fruiting in May.

36. **Knema rufa** Warb.

(Latin, *rufus* = reddish; the indumentum)

Monogr. Myrist. (1897) 556; Merrill *l.c.* (1921) 271; Masamune *l.c.* 304; J. Sinclair *l.c.* (1961) 274, 288; W.J. de Wilde *l.c.* (1979) 409; Anderson *l.c.* 268; Coode *et al.* (eds.) *l.c.* 226. **Type:** *Beccari 1798*, Borneo, Sarawak, Mt. Matang (holotype FI; isotypes G, K, P).

Tree up to 20 m tall. **Twigs** *towards apex 2–3 mm diameter*, slightly angular, *tomentose with hairs c. 0.3 mm long*, glabrescent; *bark not or faintly cracked or flaky*. **Leaves** thinly coriaceous, *on both surfaces at first densely rusty pubescent with hairs c. 0.5 mm long*, *early glabrescent*, *upper surface drying olivaceous to blackish brown*, *lower surface without blackish dots*; oblong to lanceolate, 15–30 × 1.5–4(–5.5) cm, base attenuate; midrib raised above; lateral veins 15–25(–30) pairs, prominently raised above, usually with lesser side-veins in between; petiole 1–2 cm long. **Inflorescences** simple, up to 1 cm diameter; 2–10-flowered in males; peduncle up to 2 mm long; *flowers pubescent with hairs c. 0.3 mm long*. **Male flowers:** pedicel 10–15 mm long; bracteole caducous, attached to the pedicel above the middle; buds depressed obovoid, 6–7 × 5–6 mm, often somewhat furrowed, inside red (always?); perianth at anthesis clefts to *c.* 2/3; staminal disc circular, concave, including anthers 2–2.5 mm diameter; anthers (9–) 10–15, connectives protrude slightly beyond the thecae; staminal column tapering, *c.* 1 mm long. **Female flowers** not seen. **Fruits** 1(–3) per infructescence, ellipsoid, *c.* 2.5 × 1.5 cm, *tomentose with shaggy hairs c. 3 mm long*; pericarp 2(–3) mm thick; stalk 10–20 mm long.

Distribution. Endemic to Borneo (Sarawak and Brunei).

Ecology. In primary lowland mixed dipterocarp forest on sandy clay soils, up to 200 m altitude.

37. **Knema sericea** W.J. de Wilde

(Latin, *sericeus* = silky; the indumentum on the lower leaf surface)

Blumea 25 (1979) 383, *l.c.* (1996) 394; Whitmore, Tantra & Sutisna *l.c.* 272; Coode *et al.* (eds.) *l.c.* 226. **Type:** *Jaheri 611*, Borneo, NE Kalimantan (holotype L; isotypes BO, SING).

Tree up to 20 m tall. **Bark** smooth. **Twigs** towards apex 4–5 mm diameter, pubescent with dense scale-like hairs up to 0.1 mm long, glabrescent; *bark not tending to crack or flake*. **Leaves** membranous to chartaceous, upper surface drying greenish to blackish, *lower surface silky to the touch*, *tomentose with short*, *dense*, *greyish or pale cinnamon*, *interwoven hairs c. 0.2 mm long*, *mixed with sparse stouter dendroid hairs*, without blackish dots; oblong to oblong-lanceolate, 30–45 × 9–15.5 cm, base rounded to shallowly cordate, apex rounded or acute-acuminate; midrib raised above; lateral veins 30–35 pairs, raised above, basal veins somewhat crowded; *intercostal venation reticulate*, *coarse above*; petiole stout, 1.2–2 cm long. **Inflorescences** *c.* 0.5 cm diameter, with stout peduncle up to 7 mm long; 4–10-flowered in males; *flowers densely tomentose with hairs c. 0.1 mm long*. **Male flowers:** pedicel 12–18 mm long; bracteole caducous, attached at the top of pedicel; buds subglobose, 6–10 mm diameter; perianth at anthesis clefts to *c.* 4/5; *staminal disc convex to mammillate*, including anthers circular, *c.* 3 mm diameter; anthers 10–15, stiped; staminal column *c.* 0.5 mm long. **Female flowers** not known. **Fruits** 1–2 per infructescence, *subglobose to broadly ovoid*, *3.5–5 × 3.5–3.8 cm*, pubescent with scale-like hairs *c.* 0.1 mm long; dry pericarp *c.* 5 mm thick; stalk 15–20 mm long, with bracteole scars attached at or somewhat above the middle.

Distribution. Endemic to Borneo (Sarawak, Brunei and NE Kalimantan).

Ecology. In forest at the foot of limestone hill, at 50–350 m altitude. Fruiting in January.

38. **Knema stenophylla** (Warb.) J. Sinclair

(Greek, *stenos* = narrow, *phullon* = leaf; narrow-leaved)

Gard. Bull. Sing. 16 (1958) 300, *l.c.* (1961) 276; W.J. de Wilde *l.c.* (1979) 457, *p.p.*, excl. stouter forms from Borneo, now in *K. subhirtella*, *l.c.* (1987) 129; Anderson *l.c.* 268; Whitmore, Tantra & Sutisna *l.c.* 272; Turner *l.c.* 361. **Basionym:** *Gymnacranthera stenophylla* Warb. *l.c.* (1897) 364. **Type:** *Kehding 150*, Peninsular Malaysia, Klang (in *Herb. Beccari 7714*; FI). **Synonym:** *Myristica stenophylla* (Warb.) Boerl., Handl. Fl. Ned. Ind. 3, 1 (1900) 88.

There are two subspecies; subsp. *stenophylla* occurs in Peninsular Malaysia and Sumatra, and subsp. *longipedicellata* in Borneo. The latter differs from the former by its longer pedicel of the male flowers (7–10 mm long) and fruits stalk (10–20 mm long).

subsp. **longipedicellata** (Sinclair) W.J. de Wilde

(flowers with long pedicels)

Blumea 32 (1987) 130; Coode *et al.* (eds.) *l.c.* 226. **Basionym:** *K. cinerea* (Poir.) Warb. var. *patentinervia* J. Sinclair forma *longipedicellata* J. Sinclair *l.c.* (1961) 182. **Type:** *Clemens 20345*, Borneo, Sarawak, Mukah district, G. Puai (holotype K; isotypes A, BO, G, L, NY, SAR).

Tree up to 25 m tall. **Bark** smooth or rough with some pustules or flakes when old, not striate or furrowed; inner bark reddish, granular. **Sapwood** white or cream. **Twigs** *towards apex terete or subangular*, *slender*, *up to 1 mm diameter, drying brown or blackish*, *at first tomentose with hairs up to 0.1 mm long*, sometimes mixed with longer hairs 0.2–0.3 mm long, glabrescent; *bark not tending to crack or flake*. **Leaves** *membranous to chartaceous*, *upper surface drying olivaceous to brown*, *lower surface greyish*, *without dark dots*, *with subpersistent tomentum of scattered mainly stellate*, *scale-like hairs up to 0.1 mm long*; *elliptic to lanceolate*, *(3–)5–18 × 1–5 cm*, *base cuneate*; midrib flattish to raised above; lateral veins 10–21 pairs, sunken or slightly raised, usually indistinct above; *intercostal venation coarse above*; petiole 0.6–1.6 cm long. **Inflorescences** simple or 2–3-fid, 0.1–0.3(–0.7) cm diameter; (1–)3–10-flowered in males, 1–6-flowered in females; peduncle up to 1 mm long; *flowers tomentose with persistent hairs up to 0.1(–0.3) mm long*; *perianth at the sutures up to 1 mm thick*. **Male flowers:** pedicel 7–10 mm long; *bracteole persistent or caducous*, attached to the pedicel at about the middle to near the apical part; *buds broadly obovoid*, (1.5–)2–3(–4?) mm diameter, inside cream or yellowish; perianth at anthesis clefts to 3/4–4/5; staminal disc flattish, including anthers circular to subtriangular, 1–2.2 mm diameter; *anthers 6–11*; staminal column *c.* 1 mm long. **Female flowers:** pedicel 8–12 mm long; *buds* ellipsoid to obovoid, *3.5–5 mm long*. **Fruits** 1–5 per infructescence, subglobose or obovoid, *(1.2–)1.5 × 0.7–1 cm*, *apex and* *base rounded* or sometimes somewhat attenuate, *pubescent with persistent scale-like hairs up to 0.1 mm long*; dry pericarp *c.* 1 mm thick; *stalk 10–20 mm long.*

Distribution. Endemic to Borneo (Sarawak and Brunei).

Ecology. In primary and degraded lowland mixed dipterocarp to lower montane forests, often found on hill sides, crests, ridges, occasionally in swamp and *kerangas* forest, on various types of soils including, loamy, sandy, clayey, and sandstone and shale-derived soils, up to 1200 m altitude. Flowering mainly in March–July; fruiting mainly in July–December.

39. **Knema stylosa** (W.J. de Wilde) W.J. de Wilde

(Latin, *stylosus* = with a persistent style; the fruit)

Blumea 32 (1987) 119; Whitmore, Tantra & Sutisna *l.c* 272. **Basionym:** *K. hirtella* W.J. de Wilde var. *stylosa* W.J. de Wilde *l.c.* (1979) 460. **Type:** *Mikil SAN 30179*, Borneo, Sabah, Beaufort district (holotype L; isotype SAN).

Tree up to 25 m tall. **Bark** rather smooth; inner bark pinkish; sap dark red. **Sapwood** whitish. **Twigs** *towards apex subterete*, *2–3 mm diameter, at first tomentose with hairs up to 0.1 mm long*, glabrescent; *bark drying dark brown*, *not tending to crack or flake*. **Leaves** *thinly chartaceous*, *upper surface drying olivaceous*, *lower surface without dark dots, greyish, early glabrescent or with subpersistent tomentum of scattered*, *minute hairs less than 0.1 mm long*, *sparsely mixed with scars of coarser caducous hairs c. 0.2 mm long*; *elliptic-oblong to oblong*, *12–24 × 3.5–7 cm*, *base subcordate or rounded to short-attenuate*; midrib convex above, but as a whole generally partly sunken under surface level; lateral veins 15–20 pairs, flattish or sunken above; *intercostal venation coarse above*; petiole 1–2 cm long, late-glabrescent. **Inflorescences** sessile, wart-like, simple or forked, up to 0.4 cm diameter; 3–6(–10)-flowered in males and females; *flowers tomentose with hairs c. 0.1 mm long*, *perianth at the sutures up to 1 mm thick*. **Male flowers:** pedicel 4–5 mm long; *bracteole* apical, *persistent*; *buds obovoid*, 3.5–4 × 3–3.5 mm; perianth at anthesis clefts to *c.* 2/3; staminal disc flattish, bluntly triangular, including anthers *c.* 1.4 mm diameter; staminal column tapering, *c.* 1.2 mm long, glabrous; *anthers 11*. **Female flowers:** pedicel 3–5 mm long; *buds* obovoid-ellipsoid, *c. 4.5 mm long*. **Fruits** solitary or 2–3 per infructescence, ovoid, *2.5–3.5 × 1.8–2.5 cm*, *tomentose with persistent hairs up to 0.1 mm long*, sometimes glabrescent; *style 0.5–1 mm long*, *persistent or leaving a distinct scar*; dry pericarp 1.5–2.5 mm thick; *stalk 3–6 mm long*.

Distribution. Endemic to Borneo (Sabah and NE Sarawak).

Ecology. In primary mixed dipterocarp forest on hill sides, often on blackish sandstone-derived soils, up to 800 m altitude. Flowering in June; fruiting throughout the year.

40. **Knema subhirtella** W.J. de Wilde

(Latin, *sub-* = somewhat, *hirtellus* = finely hairy; the twigs and leaves)

Blumea 32 (1987) 131; Whitmore, Tantra & Sutisna *l.c.* 272; Coode *et al.* (eds.) *l.c.* 226. **Type:** *Yii et al. S. 43132*, Borneo, Sarawak (holotype L; isotype SAR).

Tree up to 25 m tall. **Bark** dark brown or chocolate-brown, smooth or dippled, not furrowed, brittle; inner bark pink-cream, fibrous; sap pink to blood-red. **Sapwood** cream. **Twigs** *bluntly triangular*, *towards apex 1.5–2(–2.5) mm diameter*, *pubescent with hairs c. 0.1 mm long*, mixed with sparse hairs up to 0.3 mm long, glabrescent; *bark drying brown or blackish*, *not flaky*. Leaf buds tomentose with hairs 0.1(–0.3) mm long. **Leaves** *membranous*, *upper surface drying olivaceous*, *lower surface greyish*, *without dark dots*, *with persistent tomentum of scattered stellate-dendroid hairs 0.1–0.2(–0.3) mm long*; *elliptic-oblong to lanceolate*, *9–20 × (1.5–)2–5.5 cm*, *base cuneate*; midrib raised above; lateral veins 15–25 pairs, flattish to raised above; *intercostal venation coarse and distinct above*; petiole 0.8–1.2 cm long. **Inflorescences** simple or forked, up to 0.4 cm diameter; peduncle up to 1 mm long; in males 4–7-flowered, in females 1–4-flowered; *perianth at the sutures up to 1 mm thick*. **Male flowers** *tomentose with hairs 0.1–0.2(–0.3) mm long*; pedicel 2–5 mm long; *bracteole late-caducous*, attached to the pedicel at 0.5–1.5 mm below the perianth; *buds broadly obovoid*, 2.5–3.5(–4) × 2.5–3.5 mm; perianth at anthesis clefts to 1/2–3/4; staminal disc circular, flat or somewhat convex, including anthers 1.2–1.5(–2) mm diameter; *anthers (7–)9–13(–15)*; *staminal column* 1–1.5 mm long, *(almost)glabrous*. **Female flowers:** pedicel 4–7(–10) mm long; *buds* obovoid, *c. 5 mm long*. **Fruits** solitary or 2 per infructescence, broadly ellipsoid, *2–2.7 × 1.5–2 cm*, *tomentose with persistent hairs c. 0.1 mm long*; dry pericarp *c.* 1.5 mm thick; *stalk 4–10 mm long*.

Distribution. Endemic to Borneo (Sabah and Sarawak).

Ecology. In mixed hill dipterocarp forest on slopes and ridges, on sandy clay, loamy, and basalt- or shales-derived soils, up to 800(–1200) m altitude. Flowering in March–May(–August); fruiting mainly in September–October.

41. **Knema tridactyla** Airy Shaw Fig. 13.

(Greek, *tris* = three, *daktylos* = finger; with 3-forked inflorescences)

Kew Bull. 1939, no. 10 (1940) 543; Masamune *l.c.* 304 (*K. tridactyia*); W.J. de Wilde *l.c.* (1979) 434, *l.c.* (1998) 250; Coode *et al.* (eds.) *l.c.* 226. **Type:** *Richards 1220*, Borneo, Sarawak, Mt. Dulit (holotype K).

Tree up to 10 m tall. **Bark** brown, smooth. **Twigs** *towards apex* terete or faintly angular, *1.5–4 mm diameter*, *pubescent with woolly*, *dendroid hairs 0.5–1(–1.5) mm long*, *late-glabrescent*, *or with inconspicuous scale-like hairs up to 0.1 mm long and rather early glabrescent*; *bark drying brown or blackish, not tending to crack or flake*. **Leaves** *chartaceous to thinly coriaceous*, *upper surface drying olivaceous or brown*, often shining and with hair scars, *lower surface greyish*, usually with scars of coarse hairs, *without dark dots*, and either *with subpersistent tomentum of sessile-stellate hairs 0.3–0.5 mm long*, *intermixed with stronger stellate-dendroid hairs*, or *at first tomentose with remote stellate*, *scale-like hairs up to 0.1 mm long*, *early glabrescent*; *oblong to lanceolate*, 7–28 × 2–5.5(–7.5) cm, base cuneate to rounded; midrib prominently raised above, in subsp. *tridactyla* on the lower side with characteristic appressed scale-like hairs; lateral veins 10–23 pairs, flat or sunken above; petiole 0.5–1.5 cm long, tomentose with scale-like hairs, late-glabrescent. **Inflorescences** slender, *up to 1.7 cm diameter*, sessile or *with peduncles up to 3 mm long*, simple or *2–3-fid*, branches 1–2(–2.5) mm thick; (2–)4–

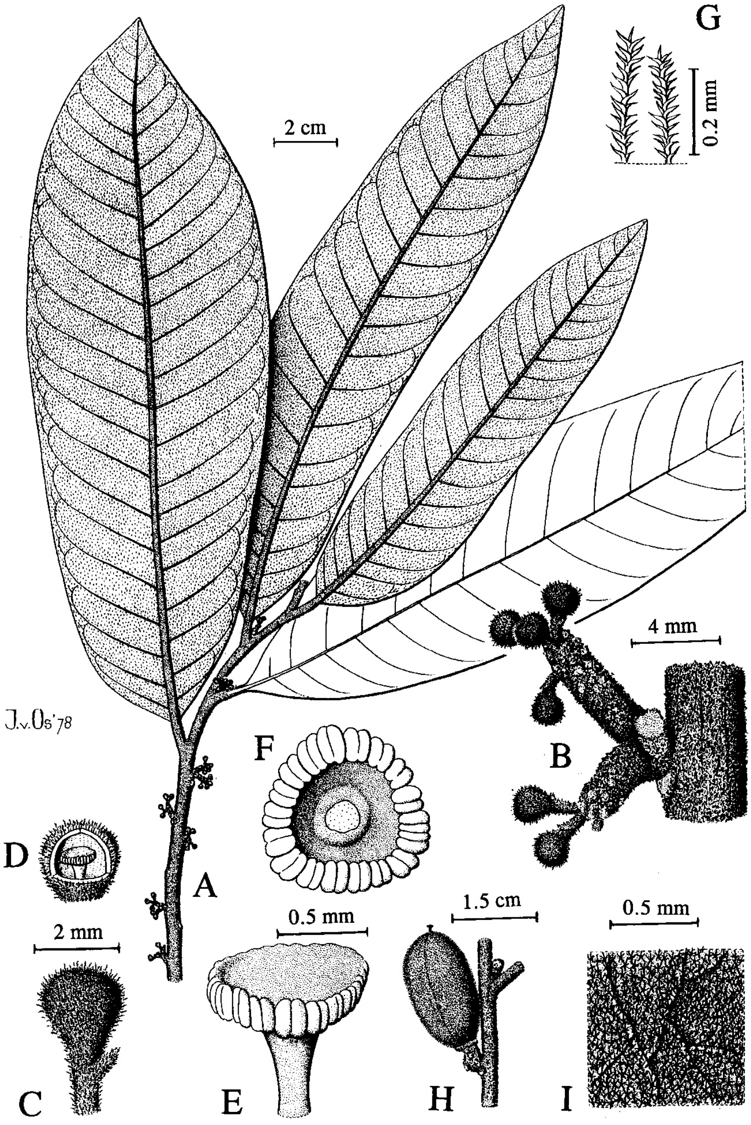

Fig. 13. *Knema tridactyla* subsp. *tridactyla*. A, flowering (male) leafy twig; B, portion of twig with male inflorescences; C, mature male flower bud; D, opened mature male flower bud; E, androecium in side view; F, androecium seen from below; G, dendroid hairs of perianth of male flowers; H, portion of branchlet with infructescence bearing fruit topped by persistent style; I, detail of lower leaf surface. (A–G from *Othman S. 21378*, H–I from *Ingah S. 27758*.)

10-flowered in males (with in addition numerous scars of pedicels), 1–5-flowered in females; *flowers pubescent with dendroid hairs 0.3–0.6 mm long or scale-like hairs c. 0.1 mm long*. **Male flowers:** pedicel 1.5–3.5 mm long; bracteole subpersistent, attached to the pedicel at or above the middle; *buds* globose to broadly obovoid, *1.5–2(–2.3)* × *1.5–2.5 mm*, inside pinkish (?); perianth at anthesis clefts to 3/4–4/5; staminal disc flat, including anthers circular or faintly triangular, 0.6–1.2 mm diameter; *anthers 5–11*; staminal column 0.3–0.7 mm long. **Female flowers:** pedicel *c*. 1.5 mm long; *buds* obovoid, *2–2.5 mm long*. **Fruits** 1(–2) per infructescence, ellipsoid or obovoid to ovoid-oblong, *1.4–2* × *0.8–1.6 cm*, *pubescent either with dendroid hairs 0.2–0.5 mm long or scale-like hairs c. 0.1 mm long*; dry pericarp 1–1.5 mm thick; *stalk 2–3 mm long*.

Distribution. Endemic to Borneo (Sabah, Sarawak and Brunei).

Ecology. In primary lowland and hill mixed dipterocarp forests on clay and yellow sandy soils, up to 1000 m altitude. Flowering throughout the year; fruiting in October, December, and February.

Key to subspecies

1. Tomentum of twig towards apex, flowers, and fruits consisting of scale-like hairs *c*. 0.1 mm long..
   subsp. **sublaevis** W.J. de Wilde
   (Latin, *sub-* = somewhat, *laevis* = smooth; the plant nearly devoid of hairs)
   Blumea 25 (1979) 434, *l.c.* (1996) 395, *l.c.* (1998) 251; Coode *et al.* (eds.) *l.c.* 226. Type: *Ilias S. 13590*, Borneo, Sarawak (holotype L; isotype SAR).
   Sarawak and Brunei.
   Tomentum of twig towards apex, flowers, and fruits consists of dendroid hairs 0.5–1(–1.5) mm long..2

2. Leaves 7–12 × 1.5–2.5 cm; lateral veins 8–12 pairs. Anthers 6...............................
   subsp. **salicifolia** W.J. de Wilde
   (Latin, with leaves like those of *Salix*)
   Blumea 43 (1998) 251. Type: *Wood SAN A 4237*, Borneo, Sabah (holotype L; isotype SAN).
   Sabah, Kota Belud district.
   Leaves larger; lateral veins 12–23 pairs. Anthers 7–11..................................3

3. Hairs 1(–1.5) mm long. Branches of male inflorescences 2–2.5 mm thick. Anthers 10–11..
   subsp. **pachydactyla** W.J. de Wilde
   (Greek, *pachus-* = thick; *dactylos* = finger; the thick branches of the inflorescence)
   Blumea 43 (1998) 251. Type: *Leopold et al. SAN 134086*, Borneo, Sabah (holotype L; isotype SAN).
   Sabah, Penampang district.
   Hairs 0.5–1 mm long. Branches of male inflorescences (1–)1.5–2 mm thick. Anthers 7–8..
   subsp. **tridactyla**
   W.J. de Wilde *l.c.* (1979) 434; Coode *et al.* (eds.) *l.c.* 226.
   Sabah, Sarawak and Brunei.

42. **Knema uliginosa** J. Sinclair

(Latin, *uliginosus* = growing in marshes)

Gard. Bull. Sing. 18 (1961) 281; W.J. de Wilde *l.c.* (1979) 428; Anderson *l.c.* 268; Whitmore, Tantra & Sutisna *l.c.* 272. **Type:** *Main 2098* (*exp. Polak*), Borneo, W Kalimantan, Pulau Nibung, Silimban, Kapuas (holotype K; isotypes A, L, SING).

Shrub or tree up to 10 m tall. **Twigs** *bluntly 2–3-angular*, *towards apex 1.5–3(–4) mm diameter, tomentose with hairs 0.5–1 mm long*, glabrescent; *bark drying brown or blackish*, *not tending to crack or flake*. **Leaves** *thinly coriaceous*, *upper surface drying olivaceous-brown*, *lower surface at first pubescent with dense hairs 0.5–1 mm long*, *early glabrescent*, *without dark dots*; oblong to lanceolate, *9–35 × 2–7.5 cm*, *base rounded to attenuate*; *midrib raised above*; *lateral veins* 8–15 pairs, *prominently raised above*; *intercostal venation raised and distinct above*; petiole *c.* 1 cm long. **Inflorescences** sessile, simple or forked, up to 0.5 cm diameter, 5–20-flowered in males, 1–5-flowered in females; *flowers pubescent with persistent hairs 0.3–0.4 mm long*; perianth at the sutures up to 1 mm thick. **Male flowers:** pedicel 5–10 mm long; *bracteole subpersistent*, *attached near the apex of pedicel*; buds depressed globose, faintly trigonous in transverse section, 3–4 × 4–5 mm, inside reddish (?); perianth at anthesis clefts to *c.* 4/5; *staminal disc convex or low-mammillate*, including anthers circular, 2–2.5 mm diameter; anthers 10–13, stiped; staminal column 0.5–1 mm long. **Female flowers:** pedicel 4–5 mm long; *buds* obovoid, *c. 5 mm long*. **Fruits** 1–3 per infructescence, broadly obovoid, *c. 1.8 × 1.5 cm*, *pubescent with hairs c. 0.3 mm long*; stalk 4–6 mm long.

Vernacular name. Sarawak—*kumpang kabang* (Iban, preferred name).

Distribution. Endemic to Borneo (Sarawak and W Kalimantan).

Ecology. In freshwater and peatswamp forests, up to 300 m altitude. Flowering in October.

43. **Knema viridis** W.J. de Wilde Fig. 14.

(Latin, *viridis* = green; leaves drying green)

Blumea 32 (1987) 121; Whitmore, Tantra & Sutisna *l.c.* 272. **Type:** *Yii S. 37882*, Borneo, Sarawak (holotype L; isotype SAR).

Tree up to 30 m tall. **Bark** smooth, or slightly scaly, or with lenticels, brown or blackish; inner bark soft; sap red. **Twigs** *towards apex (2–)2.5–4.5 mm diameter*, *bluntly 3-angular*, *tomentose with pale hairs 0.2–0.3 mm long*, *early glabrescent*; *bark drying pale brown*, *neither cracked or flaky*. **Leaves** chartaceous, upper surface drying greenish, *lower surface early glabrescent*, *without dark dots*, greyish green; oblong to oblong-lanceolate, *12–30 × 3.5–10.5 cm*, base attenuate to rounded, apex blunt to acute; midrib raised on both surfaces; lateral veins 14–23 pairs, raised on both surfaces; intercostal venation very distinct on both surfaces; petiole 1.2–1.8 cm long. **Inflorescences** wart-like, simple or bifurcate, 0.2–0.5 cm diameter, peduncle up to 2 mm long; in males 8–12-flowered, in females 4–7-flowered. **Male flowers** *tomentose with hairs c. 0.1(–0.2) mm long*; *pedicel stout*, 7–10 *mm long*, at above the bracteole scar distinctly thicker than the lower portion; bracteole caducous, leaving a distinct scar on the pedicel at about halfway; *buds depressed globose*,

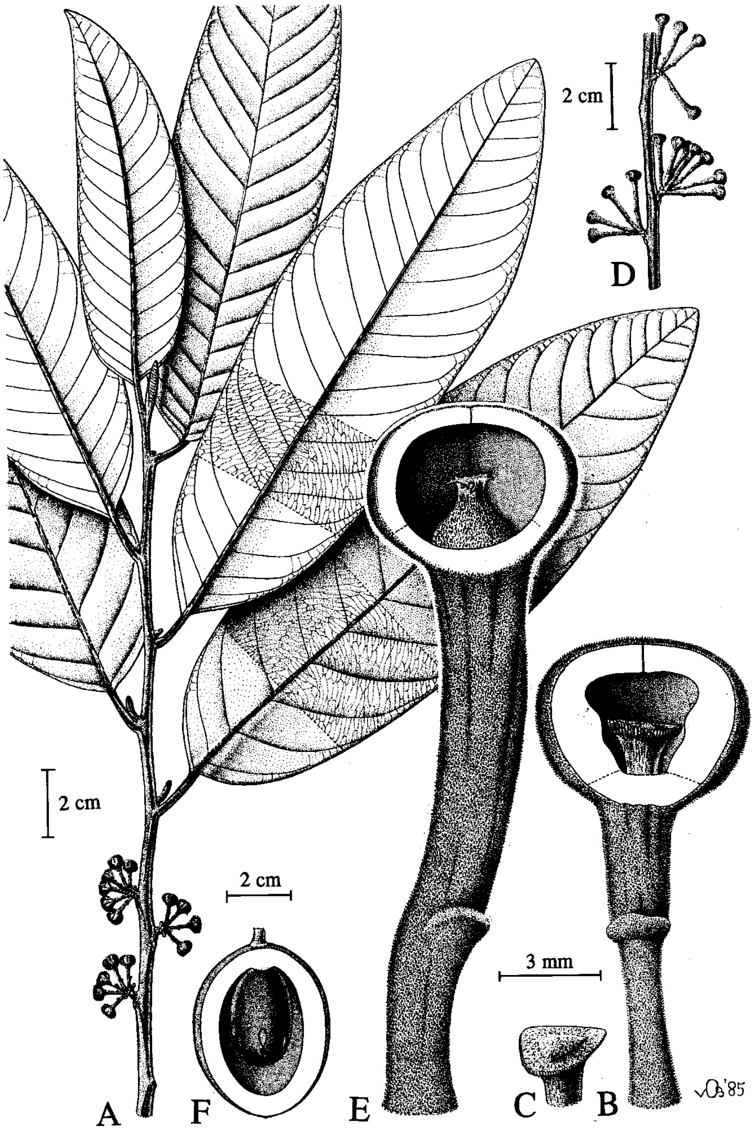

Fig. 14. *Knema viridis.* A, flowering (male) leafy twig; B, opened mature male flower bud; C, mature androecium seen obliquely from above with staminal disc subtriangular in outline; D, portion of twig with female inflorescences; E, opened mature female flower bud; F, opened fruit showing glabrous and thick pericarp, and laciniate aril. (A–C from *S. 37882*, D–E from *S. 42885*, F from *S. 38068*.)

4.5–5 × 6–7 mm, faintly trigonous in transverse section; perianth at anthesis clefts to 3/4–4/5; staminal disc flattish or convex in the centre, bluntly trigonous in outline, 2.5–3 mm diameter; anthers 25–30, closely set; staminal column tapering, 1–1.5 mm long. **Female flowers** (slightly immature): *pedicel stout*, *15–17 mm long*; buds depressed globose, *c.* 3.5 × 5 mm. **Fruits** 1–3 per infructescence, ellipsoid, *5–6 × 4–4.5 cm*, *early glabrescent*; *dry pericarp c. 10 mm thick*; stalk *c.* 15 mm long.

Distribution. Endemic to Borneo (Sarawak).

Ecology. In lowland and hill mixed dipterocarp forests on gentle and wet slopes, at 50–600 m altitude. Flowering in August–November; fruiting in September.

44. **Knema woodii** J. Sinclair

(G.H.S. Wood, 1927–1957, formerly forest botanist at the Forestry Department, Sandakan, Sabah)

Gard. Bull. Sing 18 (1961) 283; W.J. de Wilde *l.c.* (1979) 429, *l.c.* (1987) 125; Anderson *l.c.* 268; Whitmore, Tantra & Sutisna *l.c.* 272. **Type:** *Sinclair & Kadim 9298*, Borneo, Sabah, Sepilok FR, Compt. 15 (holotype SING; isotypes A, B, BM, E, K, L, M, SAN).

Tree up to 30 m tall. **Bark** grey or brown, flaking in thin strips or pieces; inner bark 8–10 mm thick, red or pale red. **Sapwood** reddish or dirty white. **Twigs** *towards apex 2.5–4 mm diameter*, *more or less* 3-*angled or ridged*, *often blackish*, *pubescent with hairs 0.1–0.2 mm long*, early glabrescent; *bark not tending to crack or flake*. **Leaves** *thinly coriaceous*, *upper surface drying olivaceous-brown*, *lower surface greyish*, *without blackish dots*, *tomentose with minute hairs 0.1–0.2 mm long*, *early glabrescent*; *oblong to (ob)lanceolate*, 15–35 × (2–)4–9 cm, base rounded to cuneate; midrib raised or not above; *lateral veins 22–30 pairs*, sunken above; petiole 1–2 cm long. **Inflorescences** sessile, simple or wart-like, 0.2–0.5(–1) cm diameter, 1–10-flowered in males and females; *flowers persistently tomentose with minute*, *pale brown hairs 0.1–0.3 mm long*. **Male flowers:** pedicel 8–15 mm long; bracteole caducous, attached to the pedicel at about or below the middle; buds subglobose, (5–)6–8 mm diameter, inside red; *perianth at the sutures 1–2 mm thick*, at anthesis clefts to *c.* 3/4; staminal disc subtriangular, flat, including anthers 3–5 mm diameter; *anthers 18–23*; staminal column *c.* 2(–3) mm long, clasped by the fleshy basal part of the hypanthium. **Female flowers:** pedicel 3–4 mm long; *buds* obovoid, *5–7 mm long*. **Fruits** 1 or 2 per infructescence, ellipsoid, *3–4 × 2–2.5 cm*, *mealy pubescent with rather pale hairs c. 0.1 mm long*, *subglabrescent*; dry pericarp *c.* 4 mm thick; *stalk c. 10 mm long*, with the bracteole-scar located at about the middle.

Distribution. Endemic to Borneo (Sabah, Sarawak and Kalimantan).

Ecology. In mixed dipterocarp forest and periodically inundated forest along rivers, on clay and sandstone-derived soils, up to 500 m altitude. Flowering throughout the year.

5. **MYRISTICA** Gronov., *nom. cons.*

(Greek, *muron* = a fragrant vegetable ointment; the nutmeg tree)

penarahan (preferred name), *darah-darah* (Malay), *kumpang* (Iban)

Fl. Orient. (1755) 141; Warburg, Monogr. Myrist. (1897) 374; Gamble, J. As. Soc. Beng. 75, 2 (1912) 226; Ridley, FMP 3 (1924) 62; J. Sinclair Gard. Bull. Sing. 26 (1958) 333, *ibid*. 28 (1968) 1; Backer & Bakhuizen *f.* FJ 1 (1964) 138; Whitmore, TFM 1 (1972) 340; Anderson, CLTS (1980) 268; Corner, WSTM 3rd. edition 2 (1988) 565; Whitmore, Tantra & Sutisna CLK 2, 1 (1990) 273; W.J. de Wilde, Blumea 38 (1994) 349, *ibid*. 40 (1995) 237, *ibid.* 42 (1997) 111, *ibid.* 43 (1998) 165; PROSEA 5, 2 (1995) 346; Coode *et al.* (eds.), CBDS (1996) 226; Argent *et al.* (eds.), MNDT-CK 2 (1997) 459.

Dioecious, *rarely monoecious or paroecious* (having male and female organs in the same inflorescence but separate, the male ones in the axils of lower bracts) *trees*; stilt roots sometimes present. **Bark** rough, sometimes longitudinally fissured, greyish brown to coal-black; sap watery, red or pink. **Twigs** *striate*, *older bark sometimes tending to crack or flake*. **Leaves** membranous, chartaceous or coriaceous, upper surface usually shining when dry, lower surface often whitish or glaucous, glabrous or with tomentum of scale-like hairs, in Borneo without dark dots; base acute, rounded or less often cordate, apex acute-acuminate or rarely obtuse; lateral veins nearly always impressed above, prominent beneath and interarching near the leaf margin; intercostal venation usually laxly reticulate. **Inflorescences** *axillary branched panicles with the flowers arranged in cymes or subumbels*, or *fascicles of flowers borne on unbranched or short-branched brachyblasts*, or less often a combination of the two types; bracts small and falling off early; *bracteoles mostly persistent*, suborbicular and *mostly embracing the base of the flowers.* **Flowers** urceolate or campanulate, less often tubular, pedicelled, often fragrant, glabrous, puberulous, pubescent or tomentose outside, glabrous inside, rusty-brown or cream-coloured; perianth (2–)3(–4)-lobed, lobes at anthesis generally reflexed; female flowers more swollen than the males. **Male flowers:** *androecium consists of an elongated synandrium which is made up of a thickish central column to which 8–30 linear anthers are completely adnate by their backsides and connate to each other by their edges*, *a rarely shallowly excavated sterile apex*, *and a stalk* (androphore). **Female flowers:** ovary subglobose, glabrous or tomentose, style absent, stigma minutely bilobed. **Infructescence** *either simple or furcate*, *short*, *subsessile or panicle-like with peduncle*, *without scars of cataphylls at the base*. **Fruits** *usually large*, subglobose, ovoid, pyriform or oblong, orange, yellow or rusty brown, glabrous, tomentose or less often lanose; pericarp thick, coriaceous, or fleshy but firm; *bracteoles persistent*. **Seeds** shining, large and conform to the fruits; testa hard, brown or brownish black; endosperm ruminate with a fixed oil and starch; *aril* red (or orange or yellow), *laciniate and clefts to the base or nearly to the base*.

Distribution. A genus comprising about 175 species, distributed from S India and Indo-China (rare) through Malesia eastwards to NE Australia, the Pacifics and Fiji. Most species are found in New Guinea, with many endemics. In Borneo 20 species occur, of which 19 are recorded in Sabah and Sarawak.

Ecology. All species are confined to undisturbed and disturbed, lowland to lower montane rainforests. Many have a restricted distribution area, and/or are confined to a restricted altitudinal range, sometimes to soils derived from specific bedrock, e.g. limestone or ultrabasic.

Taxonomy. Sinclair in his monograph (*l.c.* 1968) distinguished arbitrarily two sections, (1) sect. *Myristica*, with inflorescences generally more or less panicle-like and branched, and with a smooth, non-scar covered (often more or less flattened) common peduncle, generally lasting for one flowering season, and (2) sect. *Fatua*, with subsessile, simple or forked, scar-covered, wart-like brachyblasts, lasting generally for several flowering seasons. Within each section, 9 and 10 series respectively, are recognized. Though the differences in the general shape and architecture of the inflorescences are useful in the keys, a monophyletic division of the genus into two sections is unwarranted. In the present treatment we have refrained from recognizing any sections or series.

Key to *Myristica* species

(*Myristica fragrans*, the nutmeg of commerce, widely cultivated and occasionally escaped or remained in abandoned plantations, is not included in the key)

1. Tomentum of terminal leaf buds short, composed of minute appressed hairs 0.1–0.2 (–0.3) mm long..2
Tomentum of terminal leaf buds consisting of hairs more than 0.2 mm long.................14

2. Lower leaf surface with persistent or subpersistent dense tomentum (hairs may be very small), older leaves sometimes late-glabrescent. Fruits with minute scurfy tomentum comprising hairs *c*. 0.1(–0.2) mm long..3
Lower leaf surface glabrous or early or late-glabrescent or with scattered minute hairs. Fruits with various tomentum or glabrous or glabrescent..5

3. Flower buds (best seen in staminate flowers) usually angular in the upper portion. Twig slender, towards apex 1.5–2.5(–4) mm diameter. Leaves (8–)10–22 cm long; lateral veins 10–17 pairs ....**3. M. cinnamomea**
Flower buds not angular in the upper portion. Twig generally stouter. Leaves larger, with more lateral veins per side..4

4. Twig stout, towards apex (4–)5–8 mm diameter. Leaf upper surface drying blackish brown; lateral veins (20–)23–30(–33) pairs..................................**15. M. maxima** (in part)
Twig slender, towards apex 2–3 mm diameter. Leaf upper surface drying olivaceous; lateral veins 16–23 pairs..**6. M. depressa**

5. Fruit glabrous or glabrescent or with minute remote hairs; in glabrescent fruit sometimes some minute tomentum remaining in sheltered places near the insertion of the fruit stalk. Inflorescences peduncled; flowers glabrous or pubescent..6
Fruit with persistent dense scurfy tomentum or partly glabrescent but with dense tomentum remaining in sheltered places of the fruit. Inflorescences sessile brachyblasts or peduncled; flowers pubescent..11

6. Flower buds (especially in staminate flowers) sharply angular in the apical portion. Twig drying conspicuously yellowish. Lateral veins 8–13(–15) pairs.........**7. M. elliptica**
Flower buds not angular in the apical portion. Twig drying yellowish brown, brown, or blackish. Lateral veins (10–)12–20(–28) pairs...7

7. Marginal interarching veins of lateral veins on the lower leaf surface indistinct...............8
Marginal interarching veins of lateral veins on the lower leaf surface generally raised and distinct...10

8. Bracteole (in staminate flowers) caducous. Leaf apex acute or rounded; lower leaf surface distinctly papillose. Fruits 5–8 cm long, dry pericarp 15–20 mm thick…………………………………………………………………………**10. M. gigantea** (in part)
Bracteole (in staminate flowers) persistent, subpersistent or late-caducous. Leaf apex subacute-acuminate; lower leaf surface not papillose. Fruits 3–6(–8) cm long, dry pericarp 3–10 mm thick……………………………………………………………………9

9. Leaves membranous or chartaceous, or subcoriaceous, 7–24 cm long. Common peduncle of female inflorescences and infructescences up to 10 mm long. Fruits 3.5–6(–8) cm long, late or early glabrescent; dry pericarp 4–10 mm thick. Male flower buds 4–6(–7) mm long……………………………………………**12. M. iners** (in part)
Leaves thinly membranous, 7–14 cm long. Common peduncle of female inflorescence and infructescence slender, 10–25(–30) mm long. Fruits 3.5–4.5 cm long, early glabrescent; dry pericarp 3–4 mm thick. Male flower buds *c*. 3 mm long......**9. M. fallax**

10. Twig slender, towards apex 2–4 mm diameter. Leaves smaller and narrower, 10–30 × 4–9.5 cm; apex acute-acuminate, base rounded or acute; lateral veins 14–20 pairs. Male flower buds 3–3.5 mm long. Female flower buds 2–2.5 mm long. Fruits 4–6 cm long……………………………………………………………**14. M. malaccensis**
Twig stout, towards apex 4–8 mm diameter. Leaves generally larger and broader, 16–44 × 8–14.5(–18) cm, apex blunt or acute, base rounded or subcordate; lateral veins (16–)20–28 pairs. Male flower buds 6–8 mm long. Female flower buds *c*. 6 mm long. Fruits 7–9 cm long…………………………………………**16. M. papyracea**

11. Inflorescences short, scar-covered, sessile brachyblast……………………**5. M. crassa**
Inflorescences (and infructescences) with common peduncle, and branched……………12

12. Leaves 11–30 × 3.5–10 cm; lateral veins 13–20 pairs. Inflorescences 2–6 cm long in males, 1.5–2.5 cm in females……………………………………………**2. M. borneensis**
Leaves (16–)24–35(–40) × (5–)8–14(–20) cm; lateral veins 16–33 pairs. Inflorescences large, widely or narrowly long-paniculate, 6–18 cm long in males, (1.5–)5–9 cm long in females………………………………………………………………………………13

13. Twig stout, towards apex (4–)5–8 mm diameter. Lateral veins (20–)23–30(–33) pairs, marginal interarching veins distinct. Male flower buds 5–7 mm long…………………………………………………………………………**15. M. maxima** (in part)
Twig slender, towards apex 2.5–5 mm diameter. Lateral veins 16–24 pairs, marginal interarching veins indistinct. Male flower buds *c*. 4(–4.5) mm long............**8. M. extensa**

14. Twig stout, towards apex 5–10 mm diameter. Terminal leaf buds with very conspicuous villous tomentum comprising hairs (1–)2–3(–4) mm long…………………….**19. M. villosa**
Twig slender to rather stout, towards apex up to 6 mm diameter. Tomentum of terminal leaf buds consisting of hairs up to 1.5 mm long……………………………………………15

15. Leaves pubescent beneath. Fruits 2.5–4.5 cm long…………………………………………16
Leaves glabrous or early glabrescent beneath. Fruits 5 cm long or more………………19

16. Inflorescences (best seen in male specimens) paniculate, i.e. branched and with distinct more or less flattened main peduncles, with the flowers in subumbellate or spicate

clusters. Fruits 2.5–4.5 cm long..17
Inflorescences sessile or subsessile brachyblasts. Fruits 2.5–3.5 cm long.......................18

17. Twig rather stout, towards apex 3–5(–10) mm diameter. Leaves (12–)15–35 cm long; lateral veins 15–19(–25) pairs. Flower buds not angular in the upper portion. Fruits 2.5–4.5 cm long, densely shaggy pubescent with hairs 0.5–1(–2) mm long...**11. M. guatteriifolia**
Twig slender, towards apex 1.5–3(–3.5) mm diameter. Leaves 11–18 cm long; lateral veins (10–)12–14 pairs. Flower buds sharply angular in the upper portion. Fruits 3.5–4 cm long, glabrescent or thinly tomentose with scattered pale brown appressed hairs up to 0.5 mm long..**17. M. simiarum**

18. Twig towards apex 2–3 mm diameter. Leaves thinly coriaceous, base rounded or short-acute; lateral veins not distinct above. Fruits tomentose with scurfy hairs 0.2–0.3(–0.5) mm long..**18. M. smythiesii**
Twig towards apex 3–4(–5) mm diameter. Leaves coriaceous, base mostly rounded; lateral veins distinct above. Fruits pubescent with woolly hairs 0.5–1 mm long...**1. M. beccarii**

19. Fruits glabrous (early glabrescent). Lower leaf surface not or indistinctly papillose, concolourous with the upper surface..20
Fruits either with persistent tomentum, or late-glabrescent, or early glabrescent (in *M. gigantea*). Lower leaf surface distinctly papillose, generally paler than the upper surface...21

20. Leaves usually membranous, up to 24 cm long, base usually attenuate. Twig towards apex up to 3 mm diameter, smooth or striate, bark lower down cracked or not. Terminal leaf buds slender. Dry pericarp (4–)5–10 mm thick......................**12. M. iners** (in part)
Leaves chartaceous or thinly coriaceous, up to 35 cm long, base broadly rounded or subcordate. Twig towards apex (4–)5–6 mm diameter, bark lower down conspicuously coarsely flaky. Terminal leaf buds stout. Dry pericarp 15–20 mm thick...**4. M. corticata**

21. Twig slender, towards apex 1.5–2.5(–3) mm diameter. Leaves 7–12(–15) cm long, apex acute or rounded; lateral veins 10–15(–18) pairs. Fruits at first with scurfy tomentum comprising hairs 0.2–0.3 mm long, late-glabrescent...**10. M. gigantea** (in part)
Twig generally stouter, towards apex 3–6 mm diameter. Leaves 14–32(–35) cm long, apex acute-acuminate; lateral veins 15–22 pairs. Fruits with conspicuous persistent tomentum composed of shaggy hairs 1–2.5(–3) mm long...................**13. M. lowiana**

1. **Myristica beccarii** Warb.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Monogr. Myrist. (1897) 518; Merrill *l.c.* (1921) 269; Masamune *l.c.* 304; J. Sinclair *l.c.* (1968) 319; Whitmore, Tantra & Sutisna *l.c.* 273; W.J. de Wilde *l.c.* (1997) 140; Argent *et al.* (eds.) *l.c.* 460. **Type:** *Beccari 247*, Borneo, Sarawak (holotype FI; isotypes G, K, M, P).

Tree up to 24 m tall, with low buttresses or a few stilt roots. **Bark** rough, fissured, with narrow strips of 1–3 mm thick, or flaky, brownish black; inner bark orange-brownish; sap yellowish or red. **Sapwood** white. **Twigs** *towards apex 3–4(–5) mm diameter*, at first tomentose with hairs *c.* 0.5(–1) mm long; bark lower down blackish, somewhat flaky; lenticels absent. *Terminal leaf buds tomentose with hairs 0.5–1 mm long*. **Leaves** *coriaceous*, upper surface drying olivaceous or brown, *lower surface with persistent dense tomentum of pale cinnamon hairs (0.1–)0.2–0.3 mm long*, *mixed with scattered*, *caducous*, *emergent hairs c. 0.4 mm long*, not papillose; elliptic-oblong to oblong-lanceolate, 9–20(–25) × 3.5–6.5(–9) cm, *base mostly rounded*; midrib slightly raised above, late-glabrescent; *lateral veins* (11–)14–19 pairs, *sunken but distinct above*, interarching veins indistinct on both surfaces; intercostal venation indistinct on both surfaces; *petiole 0.5–1(–1.5) cm long*. **Inflorescence** *a sessile or subsessile brachyblast,* tomentose with hairs *c.* 0.5 mm long; males simple or forked, woody, up to 1.2 cm long, few-flowered; bracts minute; females small, 1–few-flowered. **Male flowers:** pedicel 3–4 mm long; bracteole subpersistent, 2–4.5 mm long; buds ovoid-ellipsoid, 4–5.5 × 2.5–4.5 mm, woolly pubescent with hairs 0.3–0.8 mm long; perianth 3-lobed, at anthesis clefts to nearly 1/2; androecium 2.2–3 mm long; synandrium 2–3 mm long; anthers 6–8, sterile apex irregularly somewhat blunt, 0.2–0.3 mm long, pubescent with minute pale hairs up to 0.1 mm long; androphore 0.2–0.4 mm long, at base with a dense collar of hairs 0.5–0.8(–1) mm long. **Female flowers** pubescent with rufous hairs 0.5–1 mm long; buds ellipsoid, *c.* 5 × 3 mm long; ovary ovoid (immature), 2–3 mm long. **Fruits** usually solitary, subsessile, ellipsoid-obovoid, *2.5–3.5 × 1.5–2 cm*, *rufous pubescent with woolly hairs 0.5–1 mm long*, longest towards the base; dry pericarp 1–2 mm thick; stalk rather stout, 2–4 mm long. **Seeds** ellipsoid, *c.* 2(–2.5) cm long.

Distribution. Sumatra and Borneo (Sabah, Sarawak, and Kalimantan, including Nunukan Is.).

Ecology. In lowland and hill mixed dipterocarp forests on sandy or leached sandy clay soils, and in ridge *kerangas* forest, up to 600 m altitudes. Flowering and fruiting throughout the year.

2. **Myristica borneensis** Warb. Fig. 15.

(of Borneo)

Monogr. Myrist. (1897) 401; Merrill *l.c.* (1921) 269; Masamune *l.c.* 304; Coode *et al.* (eds.) *l.c.* 226; W.J. de Wilde *l.c.* 42 (1997) 139. **Lectotype:** *Beccari 1574*, Borneo, Sarawak, Mt. Matang (hololectotype FI; isolectotypes G, K, P).

Tree up to 20 m tall; buttresses small or absent. **Bark** dark brown or blackish, smooth or rough, shallowly flaky and minutely and narrowly fissured, or longitudinally striate, not furrowed, thin, brittle; inner bark *c.* 25 mm thick, soft, red-brown; sap red, copious or not, watery. **Sapwood** soft, white. **Twigs** towards apex 2.5–5 mm diameter, sometimes yellowish, glabrescent, at first tomentose with pale hairs 0.1(–0.3) mm long; bark lower down frequently flaky; lenticels absent. *Terminal leaf buds tomentose with greyish to pale brown appressed hairs up to 0.1(–0.3) mm long*. **Leaves** membranous, chartaceous, or thinly coriaceous, upper surface drying olivaceous, *lower surface early glabrescent*

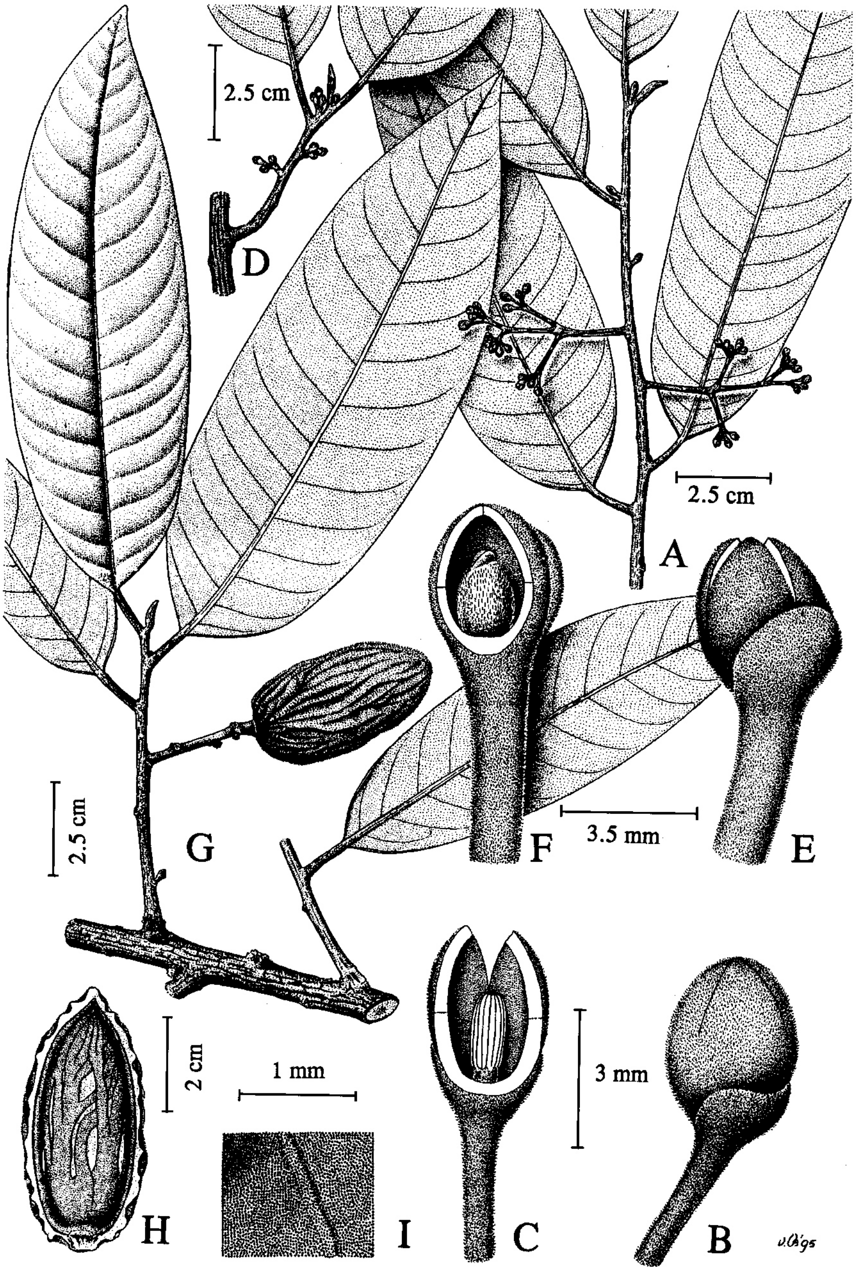

Fig. 15. *Myristica borneensis*. A, flowering (male) leafy twig; B, mature male flower bud with persistent bracteole; C, opened mature male flower bud; D, flowering (female) leafy twig; E, mature female flower bud with persistent bracteole; F, opened female flower; G, portion of branch with infructescence bearing a single fruit; H, opened dried fruit; I, portion of papillose lower leaf surface. (A from *S. 17939*, B–C from *S. 36582*, D–F from *S. 36089*, G and I from *S. 37147*, H from *S. 35852*.)

or with subpersistent sparse greyish hairs less than 0.1(–0.3) mm long, drying grey or pale cinnamon, usually distinctly papillose; elliptic-oblong or oblong-lanceolate, *11–30 × 3.5–10 cm*, base rounded or short-acute, apex acute-acuminate; midrib flat or slightly raised above; *lateral veins 13–20 pairs*, sunken above, interarching veins usually indistinct; intercostal venation indistinct; petiole 1.2–2.8 cm long. **Inflorescences** *pedunculate*, *branched*, 'mealy' tomentose with greyish hairs 0.1(–0.3) mm long; *males 2–6 cm long*, peduncle (5–)10–20 mm long, flowers of different stages of development in subumbellate clusters of 5–10; bracts minute; *females 1.5–2.5 cm long*, few-flowered, peduncle 5–10 mm long. **Flowers** drying yellow-brown or orange, *thinly pubescent with grey-brown hairs up to 0.1(–0.3 mm) long*. **Male flowers:** pedicel 3–6 mm long; bracteole rounded or irregularly 3-lobed, 1.5–2(–3) mm long; buds broadly ellipsoid, 3–4 × 2.5–3.5 mm, apex broadly rounded, slightly 3-angular; perianth at anthesis clefts to 1/2–2/3; androecium ellipsoid-cylindrical, 1.5–3 mm long; synandrium 1.5–2 mm long; anthers 7–10, sterile apex broad, flat or irregularly truncate, 0.1–0.3 mm long, or absent; androphore about as broad as the androecium, 0.2–0.8(–1) mm long, pubescent with minute hairs up to 0.1 mm long. **Female flowers:** pedicel 2–3 mm long; buds 4(–4.5) × 3.5–4 mm; perianth at anthesis clefts to *c.* 1/2; ovary ovoid, densely pubescent with minute hairs. **Fruits** 1 or 2 per infructescence, more or less ellipsoid, (4.5–)5–7.5 × 3–4.5 cm; dry pericarp 5(–8) mm thick, *cinnamon puberulent with hairs 0.1(–0.3) mm long*, *persistent or late-glabrescent*; stalk smooth, tapering, 5–9 mm long, with the scar of the bracteole located more or less immediately below the fruit. **Seeds** more or less ellipsoid, (3.5–)4–4.5 cm long.

Distribution. Endemic to Borneo (Sabah, Sarawak and Brunei).

Ecology. In primary lowland and hill mixed dipterocarp forests, and heath forest, mostly on sandy clay and clay-rich yellow soils, up to 1000 m altitude. Flowering in April–June; fruiting mainly in August–November.

3. **Myristica cinnamomea** King

(Latin, *cinnamomeus* = yellow-brown; the tomentum of lower leaf surface)

Ann. Roy. Bot. Gard. Calc. 3 (1891) 292; Warburg *l.c.* (1897) 445; Gamble *l.c.* 232; Ridley *l.c.* 65; J. Sinclair *l.c.* (1958) 358, *l.c.* (1968) 210; Whitmore *l.c.* 342; Anderson *l.c.* 268; Corner *l.c.* 565; Whitmore, Tantra & Sutisna *l.c.* 273; Turner, Gard. Bull. Sing. 47 (1995) 362; Coode *et al.* (eds.) *l.c.* 227; W.J. de Wilde *l.c.* 42 (1997) 138; Argent *et al.* (eds.) *l.c.* 460. **Lectotype:** *King's Collector 7474*, Peninsular Malaysia, Perak (hololectotype CAL; isolectotypes BM, FI, K, L, P).

Tree up to 30 m tall; crown dense; trunk at base often somewhat fluted or with low buttresses, or often with few small stilt roots. **Bark** blackish brown, or chocolate, or dark grey, britle, finely fissured, or sometimes with fine horizontal cracks or thinly flaking with appressed flakes; inner bark *c.* 5 mm thick, usually reddish brown to pinkish, soft, more or less laminated; sap red, watery, slow to appear. **Sapwood** soft, pale yellowish to pale brownish, often reddish speckled. **Twigs** *slender*, *towards apex 1.5–2.5(–4) mm diameter*, at first tomentose with hairs *c.* 0.1 mm long, glabrescent; bark lower down not or rarely flaky; lenticels absent. *Terminal leaf buds tomentose with minute appressed hairs c. 0.1 mm long*. **Leaves** chartaceous to thinly coriaceous, upper surface drying olivaceous, more or less glossy, *lower surface densely grey-brown or silvery-brown tomentose with inconspicuous hairs 0.1(–0.2) mm long*, *sometimes late-glabrescent*, indistinctly papillose, without brownish or blackish dots; elliptic to lanceolate, *(8–)10–22 × (2–)2.5–8 cm*, base attenuate, apex acute or acute-acuminate; midrib flat or somewhat raised but lying in a groove above; *lateral veins 10–17 pairs*, flat or sunken above, interarching veins indistinct; intercostal venation indistinct; petiole 1.2–2.2 cm long. **Inflorescences** short or distinctly pedunculate, branched, pubescent with mealy hairs 0.1 (–0.2) mm long; males 1–2.5 × 1–2 cm, peduncle 5–12(–15) mm long, flower buds of different stages of development and sizes in subumbellate clusters of 5–8(–10); bracts minute; females with peduncle up to 3 mm long (rarely somewhat forked), flowers in subumbellate clusters of 2–4; *flower buds more or less angular in the upper portion*, pubescent with hairs 0.1(–0.3) mm long; bracteole subpersistent or caducous. **Male flowers:** pedicel 3–6 mm long; buds ellipsoid-oblong, 5–7 × (2–)2.5–3 mm, apex subacute, angular; perianth 3(–4)-lobed, at anthesis clefts to 1/3–1/2; androecium 3.5–4(–4.5) mm long; androphore 1.5–2(–2.5) mm long, pubescent with pale hairs up to 0.1 mm long; synandrium ellipsoid-oblong, 1.8–2 mm long; anthers 6–8, contiguous, sterile apex somewhat blunt, 0.2–0.3 mm long, minutely pubescent. **Female flowers:** pedicel 2.5–4 mm long; buds ovoid-ellipsoid, apex subacute, angular, 5–6 × 2.5–3 mm; ovary ovoid-conical, *c.* 2.5 –1.5–2 mm, tomentose with dense hairs up to 0.1 mm long. **Infructescences** 0.5–2 cm long. **Fruits** solitary or 2(–3) per infructescence, broadly ellipsoid or oblong, 5–9 × 2.5–5 cm, base rounded or subattenuate, *densely scurfy pubescent with rusty hairs 0.1(–0.2) mm long*; dry pericarp (5–)8–15 mm thick; stalk rather stout, 5–10 mm long. **Seeds** ellipsoid, 3.5–5.5 cm long.

Distribution. Sumatra, Peninsular Malaysia, Singapore, Borneo, and possibly in the Philippines (Mindanao). In Sabah and Sarawak, locally common or scattered in various types of primary forests. Also in Brunei and Kalimantan.

Ecology. In primary lowland and hill mixed dipterocarp, peatswamp, *kerangas* and lower montane forests, on a variety of soils, up to 1400 m altitude. Flowering and fruiting throughout the year, but flowering predominantly in March–June.

4. **Myristica corticata** W.J. de Wilde

(Latin, *corticatus* = covered with bark; the coarsely flaked bark of twigs)

Blumea 42 (1997) 157. **Type:** *Krispinus SAN 87293*, Borneo, Sabah (holotype L; isotypes K, KEP SAR, SING).

Tree up to 25 m tall; buttresses up to 1 m tall and wide; bole straight. **Bark** brown or blackish, cracked, hard and brittle, *c.* 2.5 mm thick, peeling off in small longitudinal thin flakes; inner bark *c.* 0.6 mm thick, hard, orange-brown, reddish, or yellowish. **Sapwood** pink, red, or light brown. **Twigs** *rather stout*, *towards apex angular*, *(4–)5–6 mm diameter*, pubescent with hairs 0.5–1 mm long, early glabrescent; *bark lower down coarsely flaky*; lenticels absent. *Terminal leaf buds stout*, *tomentose with rough hairs c. 1 mm long*. **Leaves** *chartaceous* or thinly coriaceous, upper and lower surfaces drying olivaceous-brown, *lower surface glabrous*, *indistinctly papillose*; elliptic-oblong or oblong-lanceolate, *15–35 × 6–11.5 cm*, *base broadly rounded or subcordate*, apex acute-acuminate; midrib slightly raised above; lateral veins 17–24 pairs, generally sunken above, interarching veins mostly distinct; intercostal venation generally indistinct on both surfaces; petiole 1.5–2.5 cm long. **Inflorescences** pedunculate, branched, woolly pubescent with hairs 1(–1.5) mm long; males 2–4.5 × 2–3 cm, peduncle flattened, 4–6 mm long, flowers of various stages of development and sizes in clusters of 5–10, woolly pubescent with hairs 0.3 (–0.5) mm long. **Male flowers:** pedicel 4–6 mm long; bracteole persistent, broadly ovate, *c.* 3.5 mm long; buds ovoid, 5–5.5 × 4–4.5 mm, apical portion not angular; perianth 3-lobed, at anthesis clefts to *c.* 1/2; androecium slender, *c.* 4.5 × 0.8 mm; synandrium *c.* 3 mm long; anthers 7–8, sterile apex somewhat blunt, *c.* 0.2 mm long, glabrous; androphore *c.* 1.5 mm long, pubescent with hairs 0.2–0.3 mm long in the lower half. **Female flowers** not seen. **Infructescences** little-branched, 1.5–2 cm long, glabrescent. **Fruits** 1(–2) per infructescence, elliptic-oblong, *7.5–9.5 × 4–5 cm*, *at first pubescent with dense scurfy hairs less than 0.1 mm long*, *early glabrescent*; *dry pericarp 15(–20) mm thick*; stalk (2–)5 mm long. **Seeds** ellipsoid-oblong, 4.5–5.5 cm long.

Distribution. Endemic to Borneo (Sabah and Brunei).

Ecology. In primary and logged-over hill mixed dipterocarp forests, on low undulating country, hilly sides, and sandstone ridges with sandy clay soils, up to 500 m altitude. Flowering in July; fruiting in May, August and November.

5. **Myristica crassa** King

(Latin, *crassus* = thick; the thick pericarp)

Ann. Roy. Bot. Gard. Calc. 3 (1891) 293; Warburg *l.c.* (1897) 495; Gamble *l.c.* 234; Ridley *l.c.* 66; J. Sinclair *l.c.* (1958) 366, *l.c.* (1968) 435; Anderson *l.c.* 268; Turner *l.c.* 362; W.J. de Wilde *l.c.* (1997) 159. **Lectotype:** *King's Collector 5065*, Peninsular Malaysia (hololectotype CAL; isolectotypes FI, G, K, L). **Synonym:** *M. suavis* King *l.c.* 295, Warburg *l.c.* (1897) 441.

Tree up to 25 m tall. **Bark** brown, smooth to slightly and shallowly fissured longitudinally and horizontally; inner bark red. **Sapwood** white. **Twigs** towards apex 3–7 mm diameter, at first tomentose with minute hairs, early glabrescent; bark lower down not flaky; lenticels sometimes present, not distinct. *Terminal leaf buds tomentose with minute appressed hairs up to 0.1 mm long*. **Leaves** chartaceous or thinly coriaceous, upper surface drying dark olivaceous, *lower surface* greyish brown, *glabrous or with scattered scale-like hairs up to 0.1 mm long*, distinctly papillose; elliptic-oblong to oblong-lanceolate, (13–)17–40 × 4.5–12(–13) cm, base rounded to cuneate, margin often somewhat revolute when dry, apex acute-acuminate; midrib slightly raised above; lateral veins 13–18(–22) pairs, sunken above, interarching veins not distinct; intercostal venation indistinct; petiole 2–3 cm long. **Inflorescences:** *brachyblasts*, 1–2 cm long, pubescent with hairs up to 0.1 mm long, *sessile or with peduncle up to 6 mm long*; males 10–30(–many)-flowered with the flowers in different stages of development and sizes; bracts minute; females 2–5 flowered. **Flowers** *tomentose with hairs less than 0.1 mm long*, sometimes late-glabrescent. **Male flowers:** pedicel (5–)6–12(–15) mm long; bracteole subpersistent, sometimes somewhat angular at the apex, (2–)3–4 mm long; buds ovoid, urceolate to oblong, 4.5–6 × 2.5–5 mm; perianth 3-lobed, at anthesis clefts to *c.* 1/3; androecium slender, 3–3.5 × 0.5 mm; synandrium ellipsoid-oblong, *c.* 2 mm long; anthers (4–)5–8, sterile apex narrow, somewhat blunt, *c*. 0.3 mm long; androphore (0.7–)1–2 mm long, minutely pubescent in the lower 2/3 or towards the base only. **Female flowers:** pedicel rather stout, *c*. 2 mm long; bracteole caducous; buds subovoid, 4–5 × 3–4 mm; ovary 3(–4) × 2–2.5 mm, minutely pubescent. **Infructescences** short. **Fruits** 1 or 2 per infructescence, broadly ellipsoid, (3.5–)4–5.5 (–6) × 3–4 cm, *rusty pubescent with scurfy hairs c. 0.1 mm long* (the scurf rather easily rubbed off); dry pericarp (7–)10 mm thick; stalk stout, 5(–10) mm long. **Seeds** ellipsoid, 3–3.5 cm long.

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo (uncommon in Sarawak, Brunei and Kalimantan).

Ecology. In freshwater swamp, peatswamp and *kerangas* forests, up to 600 m altitude. Flowering and fruiting throughout the year.

Notes. Trees are occasionally paroecious, with male and female flowers in the same inflorescence.

6. **Myristica depressa** W.J. de Wilde

(Latin, *depressus* = flattened, sunken; the androecium with cavity at the apex)

Blumea 42 (1997) 161. **Type:** *S. 39108*, Borneo, Sarawak (holotype L; isotypes K, SAR).

Tree up to 40 m tall, sometimes with buttresses or stilt roots. **Bark** brittle, fissured or flaky, blackish; inner bark brownish. **Sapwood** white or brownish. **Twigs** *slender*, *towards apex 2–3 mm diameter*, at first tomentose with hairs up to 0.1 mm long, early glabrescent, sometimes yellowish; bark lower down coarsely striate, sometimes flaky; lenticels absent. *Terminal leaf buds pubescent with minute appressed hairs 0.1(–0.2) mm long*. **Leaves** membranous or thinly chartaceous, *upper surface drying olivaceous*, *lower surface* grey-brown, *densely pubescent with persistent 'arachnoid' hairs up to 0.1 mm long*, not papillose; oblong-lanceolate, *15–30 × 4–9 cm*, base short cuneate or rounded, apex acute-acuminate; midrib flat to moderately raised above; *lateral veins 16–23 pairs*, flat or sunken above, sometimes indistinct, interarching veins distinct or not; intercostal venation usually faint on both surfaces; petiole 1–2.5 cm long. **Inflorescences** pedunculate, branched, rather slender, pubescent with woolly hairs 0.1–0.3 mm long; males 2–3.5 cm long, peduncle 5–10 mm long, flower buds of different stages of development and sizes in subumbellate clusters of 4–8; bracts 1.5–2 mm long; females as the males but smaller. **Male flowers** tomentose with woolly hairs (0.1–)0.2(–0.3) mm long; pedicel 3–3.5 mm long; bracteole apically attached to the pedicel, often faintly 2-lobed, *c*. 2 mm long; *buds not angular in the upper portion*, somewhat carnose, ovoid or ellipsoid, 3–4 × 2.5–3 mm; perianth 3-lobed, at anthesis clefts to 3/4–4/5; androecium short and broad, sometimes club-shaped, *c*. 1.5 × 1.2 mm; synandrium broadly ellipsoid, 1–1.3 × 1–1.2 mm, sterile apex absent, the apex truncate and with cavity up to 0.3 mm deep, more or less lobed corresponding with the anthers; anthers 6–8(–10); androphore broadly cylindrical, 0.3–0.5 mm long, minutely pubescent. Mature **female flowers** not seen. **Infructescences** 0.5–2 cm long, with 1 or 2 fruits. **Fruits** ellipsoid-oblong, *5–7 × 3–4.5 cm*; dry pericarp (2–)3–6(–10) mm thick, *tomentose with dense scurfy hairs 0.1(–0.2) mm long*; stalk rather stout, roughly fissured or cracked, 3–5 mm long. **Seeds** ellipsoid, 4–5 cm long; aril pink.

Distribution. Sumatra (1 collection), Peninsular Malaysia and Borneo (Sabah and Sarawak).

Ecology. In primary mixed dipterocarp forests, on various types of soils; occasionally on inundated river banks, sandstone and diorite screes, and hill sides, up to 300 m altitude. Flowering and fruiting throughout the year.

7. **Myristica elliptica** Wall. *ex* Hook. *f.* & Thomson

(Latin, *ellipticus* = shaped like an ellipse; the leaves)

Fl. Ind. 1 (1855) 162; King *l.c.* 295; Warburg *l.c.* (1897) 435; Gamble *l.c.* 231; Merrill *l.c.* (1921) 269; Ridley *l.c.* 65; Masamune *l.c.* 304; J. Sinclair *l.c.* (1958) 353, *l.c.* (1968) 188; Whitmore *l.c.* 342; Anderson *l.c.* 268; Corner *l.c.* 565; Whitmore, Tantra & Sutisna *l.c.* 273; Turner *l.c.* 362; W.J. de Wilde *l.c.* (1997) 164; Argent *et al.* (eds.) *l.c.* 460. **Type:** *Porter* in *Wallich Cat. 6798a*, Penang (holotype K; isotypes BM, E, G, M, NY). **Synonym:** *M. elliptica* Hook. *f.* & Thomson var. *elliptica* J. Sinclair *l.c.* (1958) 353, *l.c.* (1968) 188.

Tree up to 40 m tall; bole sometimes fluted or buttressed up to 1.2 m high. **Bark** rather smooth or finely fissured or scaly, sometimes lenticellate, grey to dark brown or blackish; inner bark soft, red-brown to pink; sap watery, pink or red. **Sapwood** white to pale yellow. **Twigs** towards apex 2–4 mm diameter, *drying yellowish*, at first tomentose with greyish hairs 0.1–0.3 mm long, glabrescent; bark lower down not cracked, straw-coloured, sometimes with few lenticels. *Terminal leaf buds pubescent with glossy light brown*, *minute*, *appressed hairs 0.1–0.2(–0.3) mm long*. **Leaves** chartaceous, upper surface drying olivaceous, *lower surface* greyish olivaceous, *at first tomentose with appressed pale hairs up to 0.1 mm long*, *glabrescent*, finely pustulate but indistinctly papillose, sometimes with faint brownish dots; elliptic to oblong, 9–21(–32) × 3–9(–12) cm, base rounded to acute, apex acute-acuminate; midrib slightly raised above; *lateral veins 8–13(–15) pairs*, faint, flat or slightly raised above, interarching veins sometimes distinct; intercostal venation faint on both surfaces; petiole 1–2(–3) cm long. **Inflorescences** *pedunculate*, branched, sparsely pubescent with pale appressed hairs up to 0.1 mm long, almost glabrescent; males 1–2.5 × 1–1.5 cm, rather few-flowered, peduncle slightly flattened, 5–10(–12) mm long; flower buds of different stages of development in loose subumbellate clusters of 3–5; bracts minute; females much reduced, 1–3-flowered. **Flowers** *angular in the upper portion*, *thinly pubescent with appressed pale hairs c. 0.1 mm long*; bracteole persistent, often more or less truncate, 0.5–1(–2) mm long. **Male flowers:** pedicel 3–5 mm long; buds elliptic-oblong, sometimes slightly contracted below the perianth-lobes, 7–8(–9) × 2.5–3.5 mm, upper portion subacute, angular; perianth 3-lobed, at anthesis clefts to *c.* 1/3; androecium cylindrical, 5–7 × 1–1.5 mm; androphore 2(–2.5) mm long, glabrous or at the base minutely pubescent; synandrium 4–4.5 mm long; anthers 5 or 6, sterile apex somewhat blunt, *c.* 0.5 mm long. **Female flowers:** pedicel *c.* 3 mm long; buds ovoid-oblong, upper portion acute, angular, 6–8 × 3–4 mm; ovary conical, including style *c.* 5 × 1 mm, tomentose with dense appressed hairs *c.* 0.1 mm long. **Infructescences** often conspicuously lenticellate, with 1 or 2 fruits. **Fruits** ovoid or ellipsoid-oblong, *4.5–7.5 × (2–)2.5–4 cm*, apex sometimes beaked, base often narrowed, *at first tomentose with scattered hairs c. 0.1 mm long*, *early glabrescent*; dry pericarp dark brown, 5(–10) mm thick; stalk slender, 5–10 mm long. **Seeds** ellipsoid, 4–5 cm long.

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, and Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In primary freshwater swamp and peatswamp forests but also in lowland and hill forests on various soils, up to 500 m altitude. Flowering and fruiting throughout the year.

8. **Myristica extensa** W.J. de Wilde

(Latin, *extensus* = stretched out; the extended inflorescences)

Blumea 42 (1997) 164. **Type:** *Ilias S. 25678*, Borneo, Sarawak (holotype L; isotype SAR).

Tree up to 25 m tall; bole fluted, with or without buttresses, or with stilt roots extending up to 80 cm over the ground. **Bark** smooth or scaly, hard, *c*. 1 mm thick, cracked, at base of bole peeling off in strips, brittle, grey to blackish or dark brown; inner bark *c*. 5(–10) mm thick, brown; sap blood-red or pink. **Sapwood** brown. **Twigs** *slender*, *towards apex* subterete, *2.5–5 mm diameter*, at first tomentose with pale hairs up to 0.1 mm long, early glabrescent; bark lower down cracked; lenticels few or absent. *Terminal leaf buds tomentose with minute appressed hairs c. 0.1 mm long*. **Leaves** membranous or thinly chartaceous, upper surface drying olivaceous-brown, *lower surface* grey-brown, *at first tomentose with flat*, *open cobweb-like silvery indumentum*, *late-glabrescent*, indistinctly papillose; elliptic-oblong to oblong-lanceolate, *(16–)24–35 × (5–)8–13.5 cm*, base attenuate or narrowly rounded, apex acute-acuminate; midrib flat above; *lateral veins 16–24 pairs*, indistinct and flat or sunken above, *interarching veins not distinct*; intercostal venation usually indistinct on both surfaces; petiole 1.5–3 cm long. **Inflorescences** *pedunculate*, *branched*, almost glabrous; *males widely paniculate*, *10–15 × 6–10 cm*, peduncle 20–45 mm long, flower buds of different stages of development in subumbellate clusters of 5–10; bracts not known, bract scars usually considerably dislocated upwards; *females (1.5–)5–8 cm long* (including 30–40 mm long peduncle). **Male flowers:** pedicel slender, 9–12 mm long; bracteole persistent, 2–2.5 mm long; *buds* ovoid, *4(–4.5) × 3–3.5 mm*, apex not angular; *perianth* membranous, *thinly pubescent with hairs 0.1(–0.2) mm long*, 3-lobed, at anthesis clefts to nearly 2/3; androecium short, club-shaped, 3–3.5 × 1–1.2 mm long; synandrium ellipsoid-oblong, *c*. 2 mm long; anthers somewhat spaced, *c*. 8, sterile apex short, 0.2–0.3 mm long, somewhat blunt; androphore *c*. 1 × 1 mm, glabrous. **Fruits** 1 or 2 per infructescence, ellipsoid-oblong, *6–7 × 3–3.5 cm*; pericarp dull brown, drying 3–6 mm thick, *densely pubescent with scurfy hairs up to 0.1 mm long*; stalk 6–15 mm long. **Seeds** 5–5.5 cm long; aril orange-red to red.

Distribution. Endemic to Borneo (Sarawak, Brunei, C and E Kalimantan).

Ecology. In primary lowland mixed dipterocarp forest on undulating lands, spurs, steep slopes, and hilly crests, on clay-rich, sandy yellow loam, yellow clayey, and sandy clay soils, up to 800 m altitude. Flowering in June; fruiting mainly in March and August.

9. **Myristica fallax** Warb.

(Latin, *fallax* = deceptive; closely resembling another species)

Monogr. Myrist. (1897) 410; Merrill *l.c.* (1921) 269; Masamune *l.c.* 304; W.J. de Wilde *l.c.* (1997) 166. **Type:** *Beccari 1590*, Borneo, Sarawak, Mt. Matang (FI).

Tree up to 20 m tall; buttresses up to 1 m out. **Bark** smooth or slightly flaky, chocolate, with paler patches or whitish flakes; sap reddish, watery. **Twigs** slender, towards apex 1–1.5 mm diameter, *drying yellowish brown*, at first sparsely pubescent with scattered hairs less than 0.1 mm long, early glabrescent; bark lower down brown, inconspicuously longitudinally cracked; lenticels inconspicuous, or absent. *Terminal leaf buds tomentose with minute appressed hairs up to 0.1 mm long*. **Leaves** *thinly membranous*, *upper surface drying olivaceous*, *lower surface* paler, greyish, *at first tomentose with minute*, *scattered, pale grey-brown stellate hairs less than 0.1 mm long*, *early glabrescent*, *not papillose*; oblong-lanceolate or lanceolate, *7–14 × 2–4 cm*, base cuneate, *apex acute-acuminate*; midrib flattish or slightly raised above; *lateral veins 12–16 pairs*, flat or sunken above, faintly conspicuous below, *interarching veins indistinct*; intercostal venation indistinct; petiole slender, 1–2 cm long. **Male inflorescences** *c*. 4 cm long, *pedunculate*, branched; *peduncle c. 10 mm long*; bracts not known. **Male flowers:** *pedicel c. 8 mm long*; *bracteole c*. 0.5 mm long, *persistent*; *buds* glabrous, ovoid, *c. 3 × 2 mm*, *not angular in the upper portion*; androecium (including androphore) *c*. 2.3 mm long; androphore *c*. 1 mm long, subpuberulous, sterile apex minute, obtuse; anthers 5. **Female flowers** not known. **Infructescences** located at the apical portion of the twigs, axillary to leaves, *c*. 3 cm long; *peduncle slender*, *10–25 mm long*, with a few scars of fallen flowers, glabrous (early glabrescent). **Fruits** solitary, ovoid-ellipsoid, *3.5–4(–4.5) × 2–2.7 cm*, *glabrous* (i.e. when young tomentose with pale rusty scurfy scale-like hairs less than 0.1 mm long, *early glabrescent*); *dry pericarp 3–4 mm thick*; stalk slender, 5–10 mm long. **Seeds** ellipsoid, 2–2.5 cm long.

Distribution. Endemic to Borneo (Sarawak and E Kalimantan).

Ecology. In hill mixed dipterocarp forest on yellow sandy loam soils, at 100–600m altitude. Fruiting in August and October–November.

10. **Myristica gigantea** King

(Latin, *giganteus* = very large; probably referring to the size of the trees)

Ann. Roy. Bot. Gard. Calc. 3 (1891) 288; Warburg *l.c.* (1897) 400; Gamble *l.c.* 229; Ridley *l.c.* 64; J. Sinclair *l.c.* (1958) 343, *l.c.* (1968) 163; Whitmore *l.c.* 342; Whitmore, Tantra & Sutisna *l.c.* 273; Turner *l.c.* 362; W.J. de Wilde *l.c.* (1997) 167; Argent *et al.* (eds.) *l.c.* 460. **Lectotype:** *King's Collector 6050*, Peninsular Malaysia, Perak (hololectotype CAL; isolectotypes E, FI, K, KEP, P, SING).

Tree up to 40 m tall; with low buttresses or a few stilt-roots up to 2 m high. **Bark** generally blackish (charcoal colour), longitudinally fissured, or often flaking in strips or pieces *c*. 1 cm wide, brittle; inner bark 10–12 mm thick, brown or red; sap red, sometimes recorded as sticky. **Sapwood** white-yellow, heartwood brown. **Twigs** *drying brownish*, *slender*, *towards apex 1.5–2.5(–3) mm diameter*, at first tomentose with short conspicuous hairs 0.1–1 mm long mixed with emergent hairs 1–1.5 mm long, late-glabrescent; bark lower down usually coarsely flaky; lenticels inconspicuous or absent. *Terminal leaf buds pubescent with hairs 0.1–1.5 mm long*. **Leaves** chartaceous or thinly coriaceous, *upper surface drying olivaceous*, *lower surface greyish or pale brown*, at first tomentose with scattered hairs up to 0.1 mm long, *early glabrescent*, *distinctly papillose*; elliptic-oblong to lanceolate, *7–15 × 2–4 cm*, that of sapling shoots up to 22 × 8 cm, base rounded or attenuate, *apex rounded or acute*, in sapling leaves acute-acuminate; midrib slightly raised above; *lateral veins 10–15(–18) pairs*, sunken above, *interarching veins generally indistinct*; intercostal venation indistinct; petiole 1.2–3.5 cm long. **Inflorescences** *pedunculate*, branched, shaggy pubescent with hairs (0.2–)0.5–1 mm long, sometimes glabrescent; males 2.5–3.5 × 2.5–3 cm, peduncle 6–10 mm long, flower buds of different stages of development and sizes in subumbellate clusters of 6–12; bracts *c.* 4 mm long, caducous; females *c.* 1.5 cm long, few-flowered, *flowers pubescent with hairs (0.2–)0.5 mm long*. **Male flowers:** pedicel *c.* 4 × 0.5 mm long; *bracteole c.* 2 mm long, *caducous*; buds ovoid-ellipsoid, 4–4.5 × 3 mm, *not angular in the upper portion*; perianth 3(–4)-lobed, at anthesis clefts to 1/5–1/4; androecium slender, *c.* 3.5 × 0.8–1 mm long; androphore *c.* 1.5 mm long, pubescent with hairs *c.* 0.3 mm long in the lower 2/3; synandrium cylindrical, acutish, *c.* 2 × 0.8 mm, sterile apex absent; anthers 7–8. **Infructescences** 1–1.5 cm long, each with 1 or 2 fruits. **Fruits** broadly ovoid, *5–8 × 4.5–5 cm*, *at first scurfy tomentose with hairs 0.2–0.3 mm long*, *early or late-glabrescent* (tomentum usually persistent near insertion of the fruit stalk); *dry pericarp 15–20 mm thick*; stalk stoutish, 5–9 mm long. **Seeds** ellipsoid, 3–3.5 cm long.

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak and Kalimantan).

Ecology. In lowland mixed dipterocarp forest on sandy and sandy loam soils, up to 450 m altitude. Flowering and fruiting possibly throughout the year.

11. **Myristica guatteriifolia** A. DC.

(Latin, *guatteriifolius* = with leaves like those of *Guatteria*, an American genus of the Annonaceae)

Ann. Sc. Nat. 4, 4 (1855) 20 (*guatteriaefolia*); Warburg *l.c.* (1897) 412; Merrill *l.c.* (1921) 269; Masamune *l.c.* 304; J. Sinclair *l.c.* (1958) 350, *l.c.* (1968) 213; Backer & Bakhuizen *f. l.c.* 139; Anderson *l.c.* 268; Corner *l.c.* 566; Whitmore, Tantra & Sutisna *l.c.* 273; Turner *l.c.* 362; Coode *et al.* (eds.) *l.c.* 227; W.J. de Wilde *l.c.* (1997) 168; Argent *et al.* (eds.) *l.c.* 460. **Type:** *Cuming 1582*, the Philippines, Luzon, Batangas Prov. (G). **Synonyms:** *M. littoralis* Miq., Fl. Ind. Bat. 1, 1 (1858) 57; *M. cookii* Warb. *l.c.* (1897) 414; *M. riedelii* Warb. *l.c.* (1897) 417; *M. palawanensis* Merr., Phil. J. Sc. C. Bot. 13, 5 (1918) 283.

Tree up to 25 m tall; buttresses up to 2 m high, 30(–150) cm out. **Bark** chocolate-brown or brown-black, 2–4 mm thick, smooth or rather rough, only rarely fissured, usually cracked or scaly, flaking irregularly in more or less rectangular pieces *c.* 2 × 4 cm; inner bark 5–10 mm thick, soft, fibrous, pinkish to beef-red; sap watery, pale red to red. **Sapwood** usually pale, whitish to yellow, streaked with red; heartwood reddish. **Twigs** *rather stout*, subterete, *towards apex 3–6 mm diameter*, pubescent with hairs 0.2–0.5 mm long, glabrescent, usually without lenticels; bark of older twigs not or indistinctly flaky. *Terminal leaf buds pubescent with hairs (0.1–)0.2–0.5(–1) mm long*. **Leaves** chartaceous, upper surface drying olivaceous, *lower surface pubescent or late-glabrescent with dense*, *grey-brown or cinnamon hairs 0.2–0.3 mm long*, *mixed with scattered emergent hairs c. 0.5 (–2) mm long*; elliptic-oblong to oblong-lanceolate, *(12–)15–35 × 3–12 cm*, base rounded or attenuate, apex acute-acuminate; *lateral veins 15–19(–25) pairs*, slightly sunken above, interarching veins distinct or faint; intercostal venation distinct or faint; petiole 1.5–3 cm long. **Inflorescences** *paniculate*, *pedunculate*, densely tomentose with hairs 0.2–0.6 mm long; bracts caducous, *c*. 2 mm long; *males* 2–8 cm long, *with flowers of different stages of development in subumbellate clusters of (1–)2–10*, peduncle somewhat flattened, (0–)4–20 mm long; females few-flowered, 0.5–2 cm long. **Flowers** pubescent with hairs 0.3–0.6 mm long, *apex not angular*; bracteole (2–)2.5–3 mm long, caducous. **Male flowers:** pedicel 3–6 mm long; buds ovoid to ellipsoid, (4–)5–7 × 3.5–5 mm; perianth at anthesis clefts to 1/4–1/3; androecium (3–)3.5–5 × 0.8–1.2(–1.8) mm; synandrium cylindrical, 2–3 mm long; anthers 8–12, sterile apex up to 0.2 mm long, or with shallow cavity, subglabrous; androphore 1.5–2 mm long, towards the base with pale hairs 0.4–0.7 mm long. **Female flowers:** pedicel 1–2(–4) mm long; buds broadly ovoid, 4–6 × 3.5–6 mm; ovary broadly ovoid, tapered, 2.5–3(–3.5) mm diameter, densely pubescent with hairs *c*. 0.5 mm long, stigma obliquely 2-lobed, each lobe faintly lobulate or not. **Fruits** solitary or up to 3 per infructescence, short-ellipsoid or subglobose, *2.5–4(–4.5)* × *(2–)2.5–3 cm*; dry pericarp 3–5(–8) mm thick, *pubescent with dense shaggy hairs 0.5–1(–2) mm long*; stalk 1.5–5 mm long. **Seeds** 2–2.5(–3) cm long.

Vernacular name. Sabah—*alanagni* (Dusun, preferred name).

Distribution. Burma, possibly Thailand (no specimens seen), Indo-China (P. Condor), Sumatra, Peninsular Malaysia, Borneo (throughout), Java, Bali, and the Philippines.

Ecology. Frequently found in coastal forest/vegetation but also in forests further inland on various types of soils, including sandstone- and limestone-derived and ultrabasic soils, up to 200 m altitude. Flowering and fruiting throughout the year.

12. **Myristica iners** Blume

(Latin, *iners* = inert or sluggish; the aroma of the seed)

Bijdr. Fl. Ned. Ind. 2, 11 (1826) 575; Gamble *l.c.* 230; Ridley *l.c.* 64; J. Sinclair *l.c.* (1958) 363, *l.c.* (1968) 177; Backer & Bakhuizen *f. l.c.* 139; Whitmore *l.c.* 343; Anderson *l.c.* 268; Whitmore, Tantra & Sutisna *l.c.* 273; Turner *l.c.* 362; Coode *et al.* (eds.) *l.c.* 227; W.J. de Wilde *l.c.* (1997) 168; Argent *et al.* (eds.) *l.c.* 461. **Type:** *Blume s.n.*, W Java (L). **Synonyms:** *M. sublanceolata* Miq. *l.c.* 58; *M. vordermannii* Warb. *l.c.* (1897) 525; *M. cumingii* Warb. var. *floribunda* Airy Shaw, Kew Bull. 1939, no.10 (1940) 539.

Tree up to 40 m tall, sometimes with stilt roots. **Bark** rough, deeply fissured, 3–5 mm thick; inner bark *c*. 10 mm thick, soft, laminated, pinkish or brown; sap clear, reddish, sometimes copious. **Sapwood** white or pale coloured, sometimes red-streaked. **Twigs** *slender*, *towards apex* more or less angular, *1.5–3 mm diameter*, *drying brown*, at first tomentose with greyish hairs up to 0.5 mm long, early glabrescent; *bark lower down usually flaky*, lenticels sparse. *Terminal leaf buds slender, pubescent with hairs c. 0.2 (–0.5) mm long*. **Leaves** *membranous*, *chartaceous*, *or subcoriaceous*, *upper surface drying olivaceous-brown*, *lower surface concolourous with the upper surface*, *at first tomentose with scale-like hairs less than 0.1 mm long*, *early glabrescent*, *not papillose*; elliptic-oblong to oblong-lanceolate, *7–24* × *1.5–8(–10) cm*, *base rounded or attenuate*, *apex subacute-acuminate*; midrib slightly raised above; *lateral veins 11–16 pairs*, flat to sunken above, *interarching veins usually indistinct*; intercostal venation indistinct; petiole 1–2.5 cm long. **Inflorescences** branched, glabrescent; *males* 2–8 cm long, *peduncle slender or* *stout*, *2–30(–40) mm long*, *flower buds* of different stages of development and sizes in subumbellate clusters of 5–15, *not angular in the upper portion*; *females* reduced, *with peduncle up to 10 mm long or sometimes sessile*, 1–6-flowered; bracts caducous, 3–4 mm long. **Flowers** *thinly pubescent with woolly hairs 0.1–0.3 mm long*, *usually early glabrescent*; *bracteole* 1.5–3 mm long, *subpersistent or late caducous*. **Male flowers:** pedicel slender, 4–12 mm long; *buds* ovoid or ovoid-ellipsoid, *4–6(–7) × 2–4(–6) mm*; perianth at anthesis clefts to (1/4–)1/3–1/2; androecium 3(–6) × 0.6–1 mm long; synandrium 2–3 mm long; anthers 6–8, sterile apex 0.1–0.3 mm long, entire or shallowly lobed, glabrous; androphore cylindrical or somewhat swollen, about as broad as the synandrium, 1.2–2(–3) mm long, pubescent with hairs 0.1–0.2 mm in the lower half. **Female flowers:** pedicel 1–7 mm long; buds ovoid, 4–4.5 × 3.5–4 mm; ovary long-ovoid, *c.* 3 × (1–)1.5 mm, tomentose with dense hairs up to 0.1 mm long. **Fruits** usually 1 per infructescence, *scurfy pubescent with grey-brown hairs c. 0.2 mm long*, *usually early glabrescent*, ellipsoid or ovoid-ellipsoid, *3.5–6(–8) × 2.5–3.5(–4.5) cm*; *dry pericarp (4–)5–10 mm thick*, stalk rather slender, 5–15 mm long. **Seeds** ellipsoid, 2–4(–5) × 1–2(–2.3) cm, brown or black; aril orange to red.

Vernacular name. Sabah—*darah-darah* (preferred name).

Distribution. Cambodia, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo (throughout), and possibly in the Philippines.

Ecology. In lowland to lower montane forests on flat lands, slopes and ridges, on sandy, sandstone-derived, sandy loam, and tuff soils, up to 1800 m altitude. Flowering and fruiting throughout the year.

13. **Myristica lowiana** King

(Sir H. Low, 1824–1905, officer of the British East India Company; plant collector)

Ann. Roy. Bot. Gard. Calc. 3 (1891) 293, *p.p.* (pl. 120, fig. 1, 5, 6, 7 = *M. crassa*); Warburg *l.c.* (1897) 496; Gamble *l.c.* 235; Ridley *l.c.* 66; J. Sinclair *l.c.* (1958) 345, *l.c.* (1968) 164; Whitmore *l.c.* 344; Anderson *l.c.* 269; Whitmore, Tantra & Sutisna *l.c.* 273; Turner *l.c.* 362; Coode *et al.* (eds.) *l.c.* 227; W.J. de Wilde *l.c.* (1997) 141, 174; Argent *et al.* (eds.) *l.c.* 461. **Lectotype** (J. Sinclair, 1968): *Scortechini 1851*, Peninsular Malaysia, Perak, Port Weld (CAL, K). **Synonym:** *M. hackenbergii* Diels, Bot. Jahrb. 60, 3 (1926) 308, Masamune *l.c.* 305.

Tree up to 25 m tall; stilt roots or buttresses often present. **Bark** chocolate to blackish, hard, brittle, longitudinally fissured or ridged, or scaly; inner bark slightly laminated, pink or brown; sap watery, red. **Sapwood** white, turning brownish on exposure. **Twigs** *rather stout*, *towards apex 3–6 mm diameter*, at first pubescent with rough-woolly rufous hairs 1–1.5 mm long, glabrescent; bark lower down blackish, coarsely flaky; lenticels not distinct or absent. *Terminal leaf buds pubescent with hairs 1–1.5 mm long*. **Leaves** *coriaceous*, upper surface glossy, drying olivaceous or brown, *lower surface* grey-brown, *at first rusty pubescent with mealy hairs 0.1–0.2 mm long*, *very early glabrescent*, *distinctly papillose*; oblong to oblong-lanceolate, *14–32(–35) × 3.5–9(–11.5) cm*, base rounded or short-acute, *apex acute-acuminate*; midrib raised above; *lateral veins 15–22 pairs*, raised or sunken above, interarching veins usually not distinct; intercostal venation sunken above and rendering the leaf blade somewhat bullate; petiole 2.5–5 cm long. **Inflorescences** pedunculate, branched, woolly pubescent with rough hairs 1–1.5 mm long; bracts 3–5 mm long, late-caducous; males 2.5–5.5 × 2–3 cm, peduncle (10–)15–30 mm long, flower buds of different stages of development and sizes in subumbellate clusters of 5–10; females 1–1.5 cm long, hardly branched, few-flowered. **Flowers** pubescent, with hairs 0.5–1 mm long; bracteole subpersistent. **Male flowers:** pedicel 2–3(–5) mm long; bracteole *c.* 3 mm diameter, apex sometimes subtruncate, late-caducous; buds ellipsoid-oblong, 4–4.5 × 3 mm, apex narrowly rounded; perianth at anthesis clefts to *c.* 1/4(–1/3); androecium (3–)3.5–4 mm long; androphore cylindrical, 1.5–2 mm long, pubescent with dense hairs *c.* 0.5 mm long in the lower 4/5; synandrium oblong, 2–2.2 mm long; anthers 5–7, sometimes with lobed sterile apex (0.1–)0.2–0.3 mm long. **Female flowers:** buds ovoid, *c.* 5 × 4 mm; ovary rusty tomentose. **Infructescences** 1–1.5 cm long. **Fruits** mostly solitary, ellipsoid, *(5–)6–7 × 3.5–4 cm, velvety pubescent with persistent shaggy hairs 1–2.5(–3) mm long*; dry pericarp (5–)10–15 mm thick; stalk rather thick, 2–5 mm long. **Seeds** ellipsoid, 4–5 cm long, glossy dark brown; aril pale orange or red.

Vernacular name. Sarawak—*kumpang pendarahan* (Iban, preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and the whole of Borneo.

Ecology. In lowland and hill mixed dipterocarp forests on yellow sandy soils, in peatswamp forest, and *kerangas* forest, up to 800 m altitude. Flowering and fruiting apparently throughout the year.

14. **Myristica malaccensis** Hook. *f.*

(of Malacca, Peninsular Malaysia)

Fl. Br. Ind. 5 (1886) 104; King *l.c.* 287; Warburg *l.c.* (1897) 411; Gamble *l.c.* 230; Ridley *l.c.* 64; J. Sinclair *l.c.* (1958) 356, *l.c.* (1968) 184, *p.p.* excl. most of Bornean specimens; Whitmore *l.c.* 344; Anderson *l.c.* 269; Whitmore, Tantra & Sutisna *l.c.* 273; Turner *l.c.* 362; W.J. de Wilde *l.c.* (1997) 177; Argent *et al.* (eds.) *l.c.* 461. **Type:** *Maingay 1305*, Peninsular Malaysia (holotype K; isotype CAL). **Synonym:** *M. pandurifolia* H. Winkler, Bot. Jahrb. 49, 3 & 4 (1913) 367, Merrill *l.c.* (1921) 269, Masamune *l.c.* 305.

Tree up to 35 m tall; buttresses spreading or not, 0.5–3 m high. **Bark** smooth with narrow furrows or scaly, greenish grey to dark brown; inner bark pale yellow, soft; sap slow to appear, clear, watery, faint red. **Sapwood** white or brown. **Twigs** *slender*, *towards apex 2–4 mm diameter*, at first tomentose with hairs less than 0.1 mm long, early glabrescent; *bark lower down drying often blackish*, moderately flaky; lenticels absent. *Terminal leaf buds tomentose with minute appressed hairs up to 0.1 mm long.* **Leaves** thinly chartaceous, *upper surface drying olivaceous-brown*, *lower surface glabrous* (early glabrescent), drying greyish brown, not, indistinctly or distinctly (subsp. *papillosa*) papillose; elliptic-oblong to oblong, *10–30 × 4–9.5 cm*, *base rounded or acute*, *apex acute-acuminate*; midrib raised above; *lateral veins 14–20 pairs*, flat or sunken above, *interarching veins raised and distinct*; intercostal venation distinct; petiole 1.2–2.4 cm long. **Inflorescences** at first tomentose with minute hairs less than 0.1 mm long, early glabrescent; bracts 2–3 mm long, caducous; males narrowly paniculate, many-flowered, 7–10 × 3–4 cm, *peduncle 20–30 mm long*, flower buds of different sizes and stages of development in subumbellate clusters of 5–15, *largely glabrous*, *not angular in the upper portion*; females smaller, 1.5–2.5 cm long. **Male flowers** tomentose with hairs up to 0.1 mm long, *early glabrescent*; bracteole subcircular, *c*. 1.5 mm across, caducous or persistent, located at the apex of pedicel, early glabrescent with ciliate margin; pedicel 3–5 mm long; *buds* subglobose to ovoid, *3–3.5 × 2–3(–3.5) mm*; perianth at anthesis clefts to 1/4–1/3, or slightly over; androecium 1.5(–2) × 0.8(–1) mm, consisting almost entirely of the synandrium; anthers 6–8, *c*. 1.5 mm long, with free apices 0.1–0.2 mm long, sterile apex absent or apex with shallow cavity; androphore 0.2–0.5 mm long, glabrous. **Female flowers** small; pedicel *c*. 2 mm long; bracteole (1–)1.5 mm long, margin ciliate, persistent; *buds* broadly ellipsoid, *2–2.5 × 1.5 mm*; perianth at anthesis breaks off, leaving a persistent, disc-like collar around the base of developing young fruit; ovary conical-ovoid, *c*. 1.3 × 1 mm, almost glabrous. **Infructescences** 1–2 cm long, with few flower scars. **Fruits** 1 or 2 per infructescence, ellipsoid-oblong, *4–6 × 2.5–4 cm*, *glabrous*, *with vestigial minute tomentum in sheltered places near the stalk*; dry pericarp 5–10 mm thick; stalk 5–8 mm long. **Seeds** 3.5–4.5 cm long.

Distribution. Sumatra, Peninsular Malaysia and Borneo. Apparently a rare species, with two subspecies, both occurring in Sabah and Sarawak.

Ecology. In primary and disturbed forests on hillside, up to 700 m altitude. Flowering in June; fruiting in November–March.

Key to subspecies

Leaves 15–28 × 7–10 cm; intercostal venation strongly reticulate; lower surface very distinctly, regularly, finely papillose..

subsp. **papillosa** W.J. de Wilde
(Latin, *papillosus* = covered with papillae; the lower leaf surface)
Blumea 42 (1997) 177. Type: *Ilias S. 36528*, Borneo, Sarawak (holotype L; isotype SAR).
Endemic to Borneo (Sarawak).

Leaves smaller; intercostal venation faintly reticulate; lower leaf surface not or very irregularly and faintly papillose..

subsp. **malaccensis**
Sumatra, Peninsular Malaysia and Borneo.

15. **Myristica maxima** Warb.

(Latin, *maximum* = greatest; inference unclear)

Monogr. Myrist. (1897) 385; Gamble *l.c.* 228; Ridley *l.c.* 63; J. Sinclair *l.c.* (1958) 339, *l.c.* (1968) 131; Whitmore *l.c.* 345; Anderson *l.c.* 269; Whitmore, Tantra & Sutisna *l.c.* 274; Turner *l.c.* 362; Coode *et al.* (eds.) *l.c.* 227; W.J. de Wilde *l.c.* (1997) 139, 178; Argent *et al.* (eds.) *l.c.* 461. **Lectotype:** *King's Collector 5513*, Peninsular Malaysia, Perak, Larut (CAL, E, FI, G, K, L, MEL, SING, UPS).

Tree up to 35 m tall; crown deep and dense, pyramidal in outline, with numerous horizontal and descending branches; buttresses up to 3 m out and high, narrow. **Bark** smooth or rather rough, hard, shallowly scaly or dippled, or shallowly fissured, brown to dark brown, grey-brown, or chocalate; inner bark 10–20 mm thick, usually reddish brown, laminated, soft; sap clear, light to dark red, copious or not. **Sapwood** pale brown to whitish, also exuding red sap; heartwood brown. **Twigs** *stout*, *towards apex (4–)5–8 mm diameter*, at first tomentose with minute hairs, early glabrescent; bark lower down becoming rough and scaly, not cracked; lenticels often present but not distinct. *Terminal leaf buds tomentose with minute appressed hairs up to 0.1 mm.* **Leaves** membranous to thinly coriaceous, *upper surface drying blackish brown*, sometimes bullate, *lower surface* grey, *at first pubescent with scale-like hairs up to 0.1(–0.2) mm long*, *early or late-glabrescent*, usually distinctly papillose; elliptic or oblong-lanceolate, *16–40 × (6–)10–20 cm*, base rounded or shallowly cordate, sometimes attenuate, apex acute-acuminate; midrib flat or raised above; *lateral veins (20–)23–30(–33) pairs*, impressed above, *interarching veins usually distinct on both surfaces*; intercostal venation distinct on both surfaces; petiole 2.5–3.5 cm long. **Inflorescences** at first tomentose with minute, grey, villous hairs, subglabrescent, pedunculate, branched; males 6–12 (–18) × 3–8 cm, peduncle 20–45 mm long, flattened, *flower buds* of different sizes and stages of development in subumbellate clusters of 5–10, *pubescent*, *not angular in the apical part*, bracts small, caducous; females smaller, 5–9 cm long, flowers in fascicles of 1–5, perianth coriaceous, thinly pubescent with hairs less than 0.1 mm long. **Male flowers:** pedicel 3–10 mm long; bracteole 1.5–2 mm long with ciliate margin, broadly reniform, or shallowly 2–3-lobed, persistent; buds ovoid or ovoid-ellipsoid, 5–7 × 4–5 mm; perianth *c.* 0.7 mm thick at the sutures, at anthesis clefts to *c.* 1/2 or slightly over; androecium 3–4.5(–5) × (0.8–)1–1.2 mm long; androphore 0.5–0.8(–1) mm long, finely pubescent in the lower half; synandrium cylindrical, 2–2.5 mm long; anthers 8–12, sterile apex 0.3–0.5 mm long. **Female flowers:** pedicel 1–3(–4) mm long; bracteole broadly rounded, 2(–3) mm across, persistent; buds ovoid, 5–7 × 4–6 mm; ovary ovoid, 3–4 mm across, pubescent with appressed hairs 0.2–0.4 mm long, stigma conspicuous, 2-lipped, (0.5–)1 mm long. **Fruits** 1–4 per infructescence, ellipsoid-oblong, (4.5–)6–9 × 3.5–5 cm, *scurvy pubescent with persistent minute hairs up to 0.1 mm long*, sometimes late-glabrescent; dry pericarp 10–15 mm thick; stalk stout, 3–10 mm long. **Seeds** ellipsoid-oblong, (4–)4.5–6 cm long; aril deeply divided but lower 1/4 sometimes undivided, yellow turning to red.

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Singapore, and the whole of Borneo.

Ecology. In primary lowland to hill forests, along rocky *Saraca* streams on granite rock, on slopes and ridges with various types of soils, up to 700 m altitude. Flowering and fruiting throughout the year.

16. **Myristica papyracea** J. Sinclair

(Latin, *papyraceus* = papery; the thin dry leaves)

Gard. Bull. Sing. 23 (1968) 133; W.J. de Wilde *l.c.* (1997) 139, 178; Argent *et al.* (eds.) *l.c.* 461. **Type:** *Wood SAN A 4775*, Borneo, Sabah, Lahad Datu district, Bt. Kretam (holotype SING; isotypes A, KEP, L, MEL, SAN).

Tree up to 40 m tall; often flanged and/or with conspicuous, laterally compressed stilt roots up to 2 m high. **Bark** dark grey or blackish brown, cracked, in old trees flaking in thin papery strips; inner bark 8–13 mm thick, red-brown; sap pink, not copious. **Sapwood** pale brown or dirty white, red-brown or white-streaked with red. **Twigs** *stout*, *towards apex somewhat angular*, *4–8 mm diameter*, *drying yellowish brown*, at first tomentose with hairs up to 0.1 mm long, early to late-glabrescent; bark lower down often coarsely flaky, with or without lenticels. *Terminal leaf buds tomentose with minute appressed hairs up to 0.1 mm long*. **Leaves** thinly coriaceous, *upper surface drying olivaceous*, *lower surface* yellowish, *glabrous*, *distinctly papillose*; elliptic-oblong or oblong-lanceolate, *16–44 × 8–14.5(–18) cm*, *base rounded or subcordate*, *apex somewhat blunt or acute*; midrib above slightly raised; *lateral veins (16–)20–28 pairs*, sunken or flat above, *interarching veins raised and distinct*; intercostal venation more or less scalariform, distinct or not; petiole 2.2–4(–5.5) cm long. **Inflorescences** tomentose with scurfy hairs 0.1–0.2(–0.3) mm long, essentially paniculate, *pedunculate*; males 2–5 × 2–4 cm, peduncle 8–20 mm long, flowers few in loose clusters, buds strongly varying in size and age, *largely glabrous*, *not angular in the upper portion*, bracts 2–3(–4) mm long, caducous; females smaller, perianth coriaceous, pubescent with hairs *c*. 0.1 mm long, sometimes late-glabrescent, bracteole broadly reniform, 1.5–2 mm long, caducous. **Male flowers:** pedicel 5–8 mm long, with bracteole scar located up to 2 mm below the perianth; *buds* more or less ellipsoid, *6–8 × 4–5 mm*; perianth at anthesis clefts to 2/3–3/4; androecium subcylindrical, (4–)5–6 × 1.5–2 mm; androphore 1–2 mm long, densely pubescent with hairs *c*. 0.1 mm long; synandrium oblong, (2–)2.5–3 mm long; anthers 9–12, sterile apex 0.3–0.6 mm long. **Female flowers:** pedicel 2–4 mm long; *buds* ovoid, *c. 6 × 4 mm*, ovary (3–)4.5 × 3–3.5 mm, pubescent with hairs up to 0.1 mm long. **Infructescences** 1–3 cm long, with 1 or 2 fruits. **Fruits** ellipsoid, *7–9 × 4.5–6 cm*, the style remnant more or less lateral (always?), *at first tomentose with scurfy dark brown hairs c. 0.1 mm long*, *late-glabrescent*; dry pericarp 10–20 mm thick; stalk stout, 4–10 mm long. **Seeds** long-ellipsoid, 5–6 cm long; aril pale coral-red.

Distribution. Endemic to Borneo (Sarawak and Kalimantan).

Ecology. In mixed dipterocarp forest on various types of soils, up to 300 m altitude. Flowering and fruiting throughout the year.

17. **Myristica simiarum** A. DC.

(Latin, *simia* = ape; fruit eaten by monkeys, or inflorescence resembling an ape)

Ann. Sci. Nat. 4, 4 (1855) 29; Prod. 14, 1 (1856) 192; W.J. de Wilde *l.c.* (1997) 184. **Type:** *Callery 34*, the Philippines, Luzon, Manila (holotype G; isotype P). **Synonym:** *M. elliptica* Wall. *ex* Hook. *f.* & Thomson var. *simiarum* (A. DC.) J. Sinclair *l.c.* (1958) 356, *l.c.* (1968) 190.

subsp. **calcarea** W.J. de Wilde

(Latin, *calcareus* = growing on limestone)

Blumea 42 (1997) 184. **Type:** *Kostermans 13866*, Borneo, E Kalimantan, Berau (holotype L; isotypes BO, K, SING).

Tree up to 36 m tall; buttresses up to 1 m high. **Bark** superficially fissured or very rough and deeply fissured, hard, dark brown or red-brown, or black, pitted, *c*. 5 mm thick, peeling off in irregular strips of 2–3 cm wide and 2–3 mm thick; inner bark 10–

15 mm thick, undulate, yellowish brown or red-brown or dark red; sap watery, pale red. **Sapwood** dirty white or yellowish white; heartwood dark brown. **Twigs** terete, *slender*, *towards apex 1.5–3(–3.5) mm diameter*, pale brown, at first pubescent with yellow-brown hairs 0.1–0.2(–0.4) mm long, early glabrescent; bark lower down with or without small lenticels. *Terminal leaf buds tomentose with appressed hairs 0.5–1 mm long*. **Leaves** thinly chartaceous, very brittle when dry, upper surface drying olivaceous, *lower surface* drying greyish, *yellow-brown pubescent with persistent*, *appressed silky hairs (0.1–)0.3–0.5 mm long*, not or indistinctly papillose; ovate-elliptic or oblong-lanceolate, *11–18 × 3–7 cm*, base acute or nearly rounded, apex acute-acuminate; midrib flat or slightly raised above; *lateral veins (10–)12–14 pairs*, flat and faint above, interarching veins distinct or indistinct; intercostal venation distinct or indistinct; petiole 1.4–2.5 cm long. **Inflorescences** late-glabrescent, slender, *peduncled*, *branched*; *males paniculate*, 1.5–4 × 1.5–3.5 cm, *peduncle 7–15 mm long*, *flowers buds of different stages and sizes in clusters of 5–10*; bracts small, subpersistent or caducous; females like the males, but smaller and with fewer flowers; flowers pubescent with rusty hairs 0.2–0.3(–0.5) mm long; bracteole located at the apex of pedicel, persistent. **Male flowers:** pedicel (2–)3–5 mm long; *buds* ellipsoid-oblong, *triangular and somewhat acute at apex*, 7–8 × 2–3 mm; perianth at anthesis clefts to nearly 1/2; androecium cylindrical, (4–)4.5–5(–5.5) × 0.8–1 mm; androphore (0.5–)1–1.5 mm long, pubescent with hairs 0.3–1 mm long; synandrium (2.5–)3–3.5 mm long; anthers 8–12, sterile apex up to 0.5 mm long. **Fruits** 1–3 per infructescence, broadly ellipsoid, *3.5(–4) × 2.5–3 cm*, base contracted into pseudo-stalk 2–4 mm long, 3–4 mm broad, apex shortly acute, *glabrescent or thinly pubescent with inconspicuous greyish brown silky hairs c. (0.3–)0.5 mm long*; dry pericarp *c.* 3 mm thick; stalk slender or stout, 3–6 mm long. **Seeds** conforming to the fruits; aril bright red.

Distribution. A species with 3 subspecies, distributed in Borneo, the Philippines, Sulawesi and N Maluku. Subspecies *calcarea* is endemic to Borneo (W Sarawak and Kalimantan).

Ecology. In forests on old coral-limestone and sandstone with yellow sandy soils, on hilly country, up to 700 m altitude. Flowering in September; fruiting in June–September.

18. **Myristica smythiesii** J. Sinclair

(B.E. Smythies; 1959–1964 Conservator of Forest in Sarawak, ornithologist, botanist)

Gard. Bull. Sing. 23 (1968) 316; Anderson *l.c.* 269; Whitmore, Tantra & Sutisna *l.c.* 274; Coode *et al.* (eds.) *l.c.* 227; W.J. de Wilde *l.c.* (1997) 140, 185. **Type:** *Ashton, Smythies & Wood SAN 17440*, Borneo, Brunei, Badas FR (holotype SING; isotypes A, BO, BRIS, KEP, K, L, SAN).

Tree up to 18 m tall; sometimes with small buttresses or stilt roots. **Bark** smooth, with fine longitudinal striation or narrowly fissured or flaky, dark grey or brown-black; inner bark soft, red-brown. **Sapwood** soft, orange-yellow; heartwood deep red. **Twigs** *slender*, *towards apex 2–3 mm diameter*, pubescent with hairs 0.3–0.5 mm long, glabrescent; bark lower down dark brown or blackish, longitudinally cracked, sometimes flaky; lenticels absent. *Terminal leaf buds pubescent with coarse hairs 0.5(–1) mm long*. **Leaves** *thinly coriaceous*, upper surface drying olivaceous, late-glabrescent on midrib towards the base, *lower surface grey or cinnamon tomentose with persistent hairs 0.1–0.2 mm long*, *mixed with scattered emergent hairs 0.3–0.4 mm long*, indistinctly papillose; elliptic-oblong or oblong-lanceolate, 8–20 × 2–6 cm, *base rounded or shortly acute*, apex acute-acuminate (sometimes somewhat blunt); midrib raised above; *lateral veins 12–15(–18) pairs*, *faint*, *flat or sunken above*, interarching veins indistinct; intercostal venation indistinct or invisible; petiole 0.7–1.5 cm long. **Inflorescences** *simple or forked brachyblasts*, *sessile or with stalk 1–1.5 mm long*, pubescent with brown-red hairs 0.5(–1) mm long; males up to 0.6(–1) cm long, at apex with few flower buds of varying stages of development; bracts minute, caducous; flowers pubescent with hairs 0.3–0.5(–1) mm long. **Male flowers** (immature)**:** pedicel (2–)3 mm long; bracteole subcircular, faintly 3-lobed, *c*. 1.5 × 2 mm, subpersistent; buds ovoid to ellipsoid-oblong, 3–3.5 × 2 mm, apex rounded; perianth at anthesis clefts to 1/4(–1/3); androecium *c*. 1.5 × 0.4 mm; synandrium 1–1.2 mm long, anthers 5–6, sterile apex blunt, *c*. 0.2 mm long; androphore *c*. 0.3 mm long, pubescent with dense hairs *c*. 0.2 mm long. **Female flowers** not seen. **Fruits** solitary, almost sessile, broadly ellipsoid, *2.5–3.5(–3.8) × 2–2.4 cm*, *densely pubescent with scurfy hairs 0.2–0.3(–0.5) mm long*; dry pericarp 1(–2) mm thick; stalk rather stout, 3–6 mm long. **Seeds** broadly ellipsoid, *c*. 2.5 cm long, red-brown, shining; aril red.

Distribution. Endemic to Borneo (Sarawak and Brunei).

Ecology. In primary mixed dipterocarp forest on hill slopes, also in *kerangas* and peatswamp forests, on yellow sandy clay or loam soils and shallow peat overlying clay, up to 700 m altitude. Flowering and fruiting in April–July.

19. **Myristica villosa** Warb. Fig. 16.

(Latin, *villosus* = long shaggy hairy; the terminal leaf buds, flowers, fruits)

Monogr. Myrist. (1897) 419; Merrill *l.c.* (1921) 270; Masamune *l.c.* 305; J. Sinclair *l.c.* (1968) 311; Anderson *l.c.* 269; Whitmore, Tantra & Sutisna *l.c.* 274; Coode *et al.* (eds.) *l.c.* 227; W.J. de Wilde *l.c.* (1997) 140, 188; Argent *et al.* (eds.) *l.c.* 462. **Lectotype:** *Beccari 1526*, Borneo, Sarawak, Mt. Matang (hololectotype FI; isolectotype K).

Tree up to 40 m tall, occasionally with stilt roots. **Bark** hard, rough, sometimes smooth or finely scaly, blackish, flaking into strips (1.5–)2–3 mm wide and long, and *c*. 1 mm thick; inner bark reddish brown. **Sapwood** cream or pale brown; sap red. **Twigs** *stout*, *towards apex 5–10 mm diameter*, *at first villose with hairs (1–)2–3(–4) mm long*, glabrescent; *bark lower down coarsely and longitudinally cracked and flaky*; lenticels absent. *Terminal leaf buds conspicuously pubescent with hairs (1–)2–3(–4) mm long*. **Leaves** chartaceous or thinly coriaceous, upper surface drying olivaceous or brown, lower surface late-glabrescent (old leaves) or with persistent tomentum of dense, grey or cinnamon hairs 0.1–0.2 mm long mixed with spaced unbranched uniseriate emergent hairs 1–3 mm long, indistinctly papillose; elliptic-oblong or oblong, (15–)20–38(–40) × 6–12.5(–13) cm, base acute or rounded, apex acute-acuminate; midrib raised above; lateral veins 20–25 pairs, sunken above, interarching veins usually distinct; intercostal venation distinct; petiole (1.2–)2–2.5 cm long, late-glabrescent. **Inflorescence** a sessile scar-covered brachyblast, pubescent; males simple or 2–4-furcate, 0.5–1.3 × 0.5–1 cm, at apices with 1–3 subsessile flowers; bracts minute, caducous; females similar, shorter, with 1 or 2 flowers more or less hidden in coarse pubescence; perianth coriaceous, tomentose with villose hairs 1–2 mm long; bracteole late-caducous. **Male flowers:** pedicel rather thick, 3–4(–5) mm

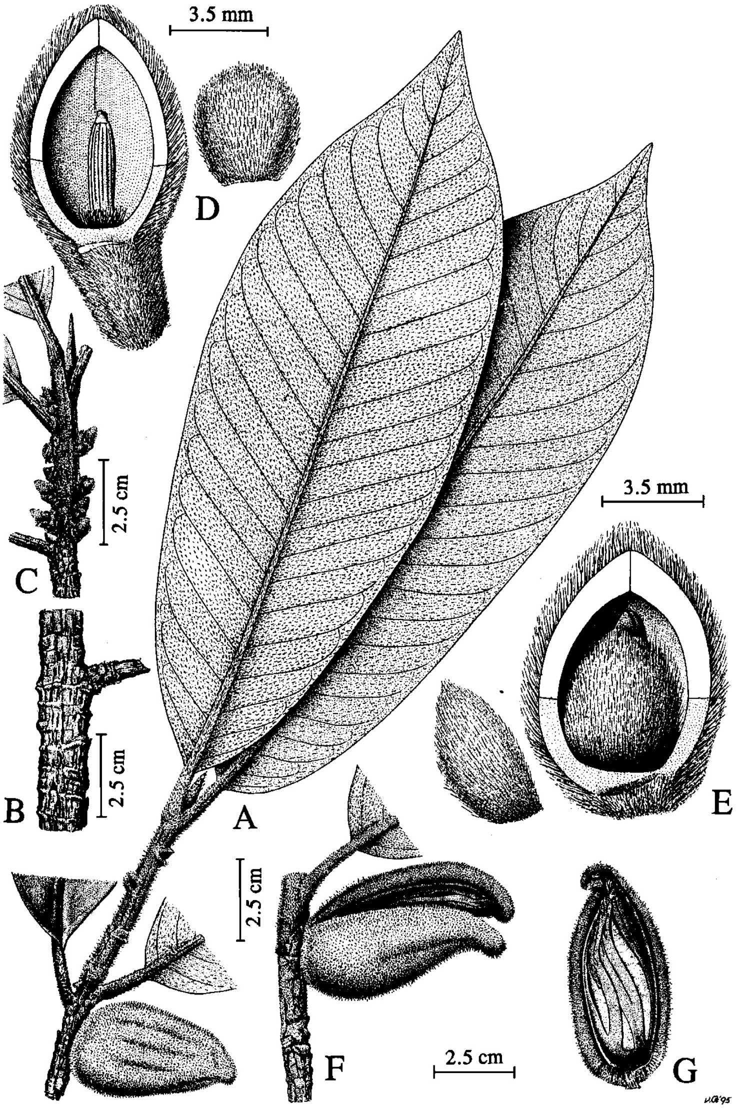

Fig. 16. *Myristica villosa*. A, fruiting leafy twig; B, portion of older twig; C, upper portion of leafy twig with few-flowered, distichous male inflorescences; D, opened mature male flower bud; E, opened mature female flower bud; F, portion of leafy twig with infructescence bearing a single mature fruit; G, opened mature fruit. (A from *S. 39444*, B, F and G from *Mogea & de Wilde 3502*, C from *Anderson & Hou 488*, D from *Paymans 33*, E from *S. 29211*.)

long; buds ovoid or ovoid-ellipsoid, 6–8 × 4–5(–6) mm, apex somewhat blunt; perianth at anthesis clefts to *c*. 2/3; androecium slender, 4–5 mm long; synandrium narrowly cylindrical, 3.5–4.5 × 0.6 mm; anthers *c*. 6, sterile apex somewhat blunt, (0.2–)0.3–0.5 mm long; androphore slender, *c*. (0.5–)1 mm long, at base with a collar of pale hairs *c*. 1 mm long. **Female flowers:** pedicel *c*. 1 mm long; buds ovoid, *c*. 8(–10) × (5–)6–8 mm; ovary ovoid, 5–6 × 4 mm, pubescent with hairs 1–1.5 mm long. **Fruits** 1 or 2 per infructescence, subsessile, broadly ovoid-ellipsoid, 4–6(–8) × 2.5–4(–4.5) cm, apex often gradually narrowed with the tip somewhat uncinate, *pubescent with hispid hairs 2–3(–4) mm long*; dry pericarp 3–6(–8) mm thick; stalk up to 5 mm long. **Seeds** broadly ellipsoid, 3–5 cm long; aril red, coarsely laciniate, the laciniae finely divided at the top.

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In primary hill mixed dipterocarp forest, marshy forest, and *kerangas* forest, on various types of soils, up to 1200 m altitude. Flowering in February, June and August–September; fruiting in May–September.

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MNDT-CK

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FJ

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FTSB

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TBS

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EPMP

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TS

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CLBD

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WSTM

Flora Malesiana
FM

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TNB

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OFMSP

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TFPF

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PB

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EPB

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EB

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PEB

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MPESA

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CST

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FMK

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TFM

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CLK

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DFPF

Wong, T.M. 1982. A Dictionary of Malaysian Timbers. Malayan Forest Records No. 30. Forest Research Institute, Kepong, Kuala Lumpur
DMT

COMMONLY USED ABBREVIATIONS FOR LOCALITIES

English		Malay	
Word	**Abbreviation**	**Word**	**Abbreviation**
Central	C	Bukit	Bt.
Division	Div.	Gunung	G.
East	E	Kampung	Kg.
Forest Reserve	FR	Sungai	Sg.
Island	Is.	Tanjung	Tg.
Mount	Mt.		
National Park	NP		
North-East	NE		
North-West	NW		
River	R.		
South	S		
South-East	SE		
South-West	SW		
West	W		

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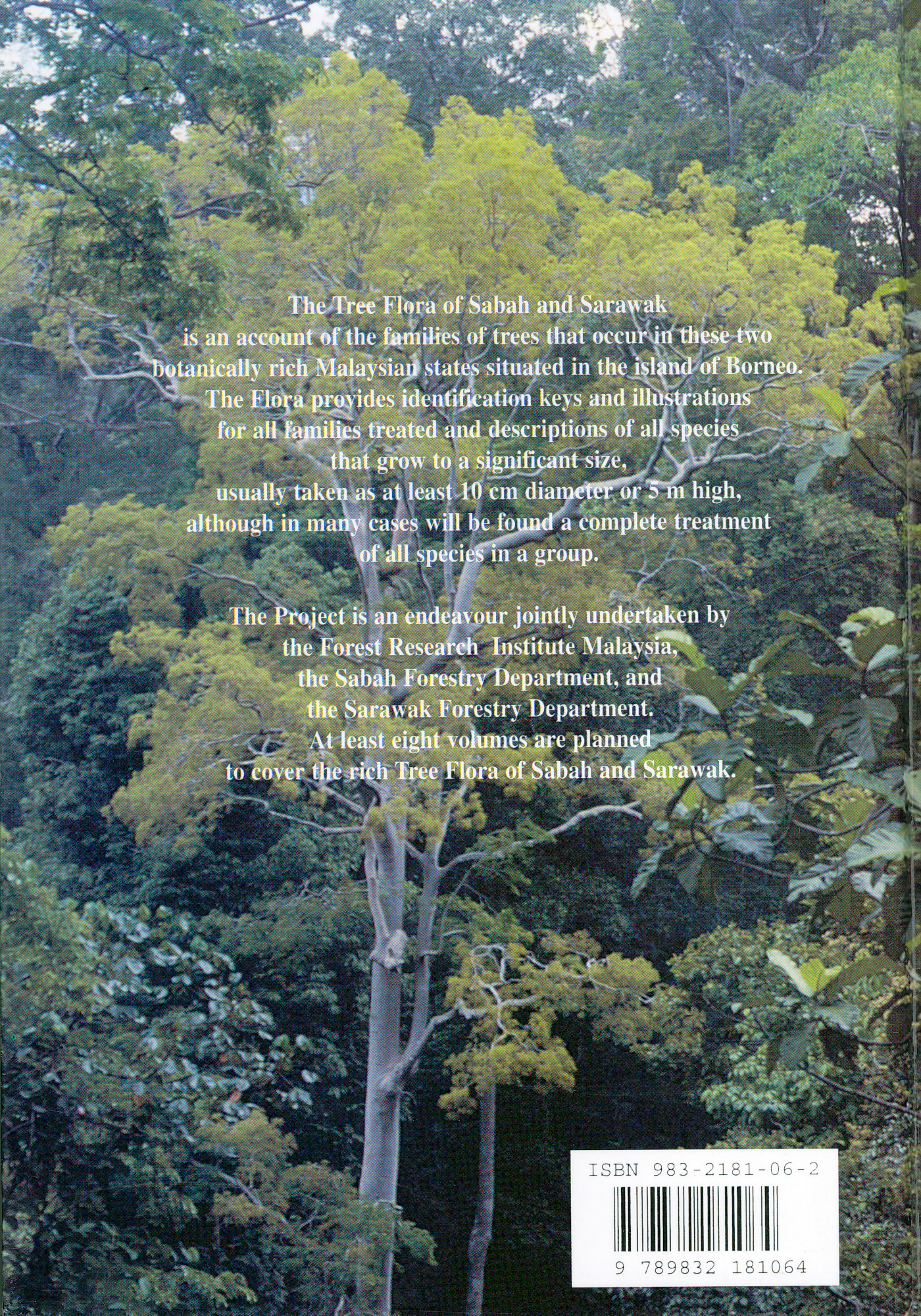

The Tree Flora of Sabah and Sarawak
is an account of the families of trees that occur in these two
botanically rich Malaysian states situated in the island of Borneo.
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for all families treated and descriptions of all species
that grow to a significant size,
usually taken as at least 10 cm diameter or 5 m high,
although in many cases will be found a complete treatment
of all species in a group.

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